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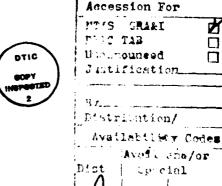
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problems using the compressor simulation to help the user become familiar with the program deck.

FOREWORD

United Technologies Corporation, Pratt & Whitney Aircraft Group, Government Products Division prepared this document for the Air Force Aero Propulsion Laboratory to meet the requirements of a User's Manual under Contract F33615-79-C-2013, Research on Software for Optimization of Vane and Bleed Settings in Multi-Stage Axial Compressors. This document complies with the Contract Statement of Work Item 5.0. The work described in this report was performed during the period 15 May 1979 to 15 May 1981. Efren Strain (1/Lt, USAF) is the Air Force Program Manager.

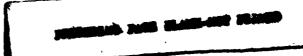


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SECTION I

INTRODUCTION

Gas turbine engines for jet aircraft must maintain high performance over a wide range of flight conditions. Thus, many of the components in these engines incorporate variable-geometry configurations and bleed systems to meet the requirements of changing environments. The fan and compressor normally contain a combination of variable vane rows and bleeds to accomplish this objective. Hence, optimization of variable vanes and bleeds or selection of the best vane and bleed schedule plays a very important role in compression system development. During initial development, most compressors are built with all vane rows variable, even though only a few rows may be variable in the final design configuration. Optimization objectives vary from configuration to configuration. However, typical examples of parameters requiring optimization include overall efficiency, surge margin, airflow, and pressure ratio.

Current optimization techniques generally consist of running a matrix of test points with various geometry settings, shutting down the test article, reviewing the interstage aero-dynamics, selecting a new series of test points using engineering judgement, and further diagnostic testing. This process is very time-consuming and expensive and rarely achieves a true optimum.

Compressor test facilities are often linked to large computers for online data feedback. Experience in compressor development and system simulation indicates that utilizing a software package through a logical series of iterations could guide decisions of the test engineer and, thus, reduce the number of data points and test time required to achieve an optimum performance goal. Ultimately, a system could conceivably be used to control the search for optimum performance. This contract effort developed a computer program in FORTRAN IV language capable of guiding the optimization of vane and bleed settings in multi-stage axial compressors.

The technical approach to the development of software for optimization of vane and bleed settings in multi-stage axial compressors involved definition of optimization goals, development of the performance-seeking logic, creation of a computer program to complement the logic, and demonstration of the function of the software.

This user's manual describes the vane and bleed optimization computer program (Customer Computer Deck CCD 1182). The program includes the capacity of handling four variable vanes and one bleed. The basic goal-seeking algorithm is the COPES/CONMIN approximate optimization method described in Reference 1. The program includes a stage-by-stage compressor model that simulates an eleven-stage, four variable-vane compressor to demonstrate program capabilities. This document presents sample problems using the compressor simulation to help the user become familiar with the program deck.

ERRATA

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3	3 from top	iterative	interactive
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29	8 from top	CONMIM	CONMIN
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SECTION II

PROGRAM DESCRIPTION

Computer program CCD 1182-0.0, developed on an IBM 3033 computer, is a FORTRAN program capable of guiding the optimization of vane and bleed settings in multi-stage axial compressors. Operated through an iterative terminal, the computer program is designed to be used in a manual mode with real-time data reduction. Inputs include the optimization goal, vane and bleed setting limits (e.g., ± 10 deg about the base vane setting), vane and bleed initial settings, performance constraints, and compressor rig measurements of overall performance. The main element of the computer program consists of the COPES/CONMIN approximate optimization algorithm that provides the test engineer with information required for the next vane or bleed setting. Flow charts showing program logic appear in Figures 1 and 2

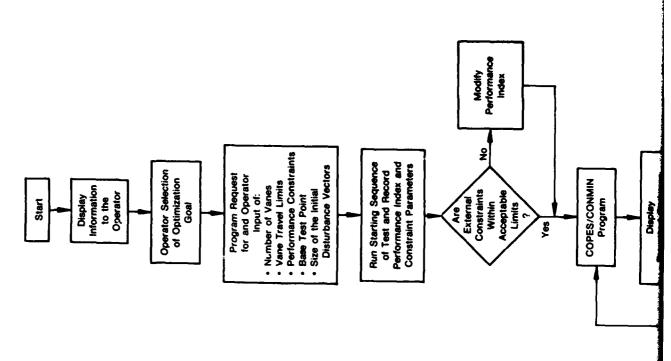
The vane optimization program primarily performs an information management task. The program supplies the computer terminal with several successive information displays based on stored data. The operator initially selects one of seventeen optimization goals summarized on the display screen. This display alone is sufficient to describe required operator actions and specific test goals.

The operator will then be prompted for the number of variable vanes and bleeds (N) to be optimized, upper and lower bounds for vane angle and bleed flow, and the size of the incremental vane and bleed variation used for the first N+1 test points. At this point, the program will tell the operator to run the base condition from which the optimization will begin. The operator is then prompted for the vane and bleed settings, and performance index (and constraint values, if applicable). The performance index and constraint values are defined based on the optimization goal selected. These may be efficiency, stall margin, corrected flow, or pressure ratio, all of which are available from the compressor test facility. The first basis vane angle and bleed perturbations are calculated and returned to the operator. The performance index and constraint values are input to the terminal. Additional basis vane angle and bleed perturbation cases are run until N+1 test points are run. The points run provide an initial model of the performance index function. After the performance index model is created, multiple optimization passes are made using this approximate design model. The approximated optimum vane and bleed settings (as determined by this pass) are sent to the operator. During the setting of new conditions, the operator monitors for external constraints, such as flutter or blade strain. If and when these limits are reached, the performance index may be modified to account for an aeromechanical constraint boundary. A convergence check and test for maximum iterations is made. The program control will return to COPES/COMMN with the new data point. The COPES performance index model is updated and a new optimization iteration proceeds.

Following a convergence at the optimum, a description of the convergence criteria will be displayed and a complete documentation of the optimization path will be printed. The following paragraphs describe the program elements in detail.

INITIALIZATION

Data initialization occurs in two ways: through block data and through operator input. Block data is used to initialize the data which generally does not change from one test case to another. The optimization program will ask the operator for any further information required to complete the initialization for a given test case.



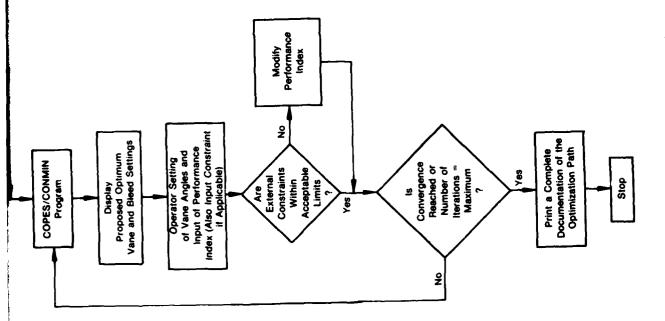


Figure 1. Vane Optimization Logic

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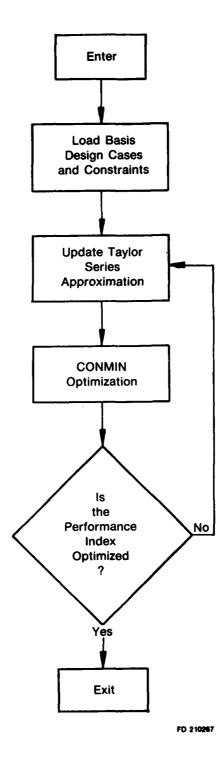


Figure 2. COPES/CONMIN Approximate Optimization Interface

COMPUTER TERMINAL DISPLAYS

The program title page, shown in Figure 3, will be automatically displayed on the terminal once the program has been loaded into the computer and the program is operational. Once the user initiates the program operation, a list of optimization goals will appear on the terminal for selection of the specific goal desired. A sample of the second display appears in Figure 4. Following selection of the desired goal, the interactive terminal will display the choice for verification. Typical versions of this display \geq shown in Figures 5 and 6.

The displays that follow on the terminal perform four functions, as described below:

- 1. Generate reminders of compressor operating conditions which may need to be held during the optimization process
- 2. Set upper and lower bounds for vane settings and performance constraints
- 3. Define the starting sequence of the test
- 4. Prompt the operator to make certain vane movements and perform efficiency and/or stall margin calculations.

Data entry displays will always repeat the entered information and await an accuracy approval or a correction command. Figures 7 through 16 show examples of how these functions are performed.

DATA STORAGE (ERROR RECOVERY)

The internal logic of COPES/CONMIM is incapable of "backing out" the previous input data if an error has been incurred. To minimize errors, the terminal input data, as interpreted by the computer, is redisplayed for verification prior to being stored. If an error is still made, a complete restart of the optimization logic is required. However, the compressor (or compressor model) need not be rerun. The computer program is reinitialized by the statement RFLAG=1. and the data values are re-entered exactly as they were originally input. Operator prompting will continue as during normal operation.

STARTING SEQUENCE OF TESTS

The basic aim of the COPES/CONMIM approximate optimization is to optimize an approximate surface by Taylor series expansion. To provide an initial model of this surface, a sequence of tests is performed wherein each vane and bleed setting is randomly varied. The minimum number of tests is N+1. Figure 17 presents the suggested starting sequence for up to four variable vanes and one bleed. Incremental vane and bleed settings are an operator input and may be chosen based on the expected performance sensitivity to vane angle. For high stage-loading compressors, a value between ± 1 and ± 2 deg is suggested. Note that to reduce experimental error, vanes are not reset between tests in this sequence.

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STATOR VANE OPTIMIZER

PROTOTYPE SOFTUARE CAPABLE OF GUIDING THE OPTIMIZATION OF

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

BY: PRATT & UHITNEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION

PLEASE HIT RETURN TO CONTINUE

Figure 3. Title Page

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Figure 4. Optimization Goal Menu

CORRECTED SPEED (RPMC) AND DISCHARGE VALUE SETTING (DUS) CONSTANT YOU HAVE SELECTED TO OPTIMIZE EFFICIENCY HOLDING LITH NO CONSTRAINTS ON SURGE MARGIN IS THIS THE DESIRED OPTIMIZATION GOAL ? (Y/N) Ë

75.4

1

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Figure 5. Display for Optimization Goal 1

You Have Selected To Optimize Efficiency Holding Ä

Corrected Speed (RPMC) and Discharge Valve Setting (DVS) Constant

While Constraining Surge Margin to a Minimum Valve Is This the Desired Optimization Goal ? (Y/N)

Figure 6. Display For Optimization Goal 4

ENTER VALUE FOR RPMC (INCLUDE DECIMAL POINT) YOU HAVE SELECTED TO HOLD RPMC CONSTANT AT A VALUE OF DO YOU AGREE? (Y/N) Ë

Ĭ.

Figure 7. Compressor Operating Condition Display

ENTER VALUE FOR DUS (INCLUDE DECIMAL POINT) 1.00000 YOU HAVE SELECTED TO HOLD DUS CONSTANT AT A VALUE OF , DO YOU AGREE? (Y/N) : : U: : 3 : A:

Figure 8. Compressor Operating Condition Display

HOW MANY UANES DO YOU WISH TO OPTIMIZE? (MAX-4) YOU HAVE CHOSEN TO OPTIMIZE 4 VANE ANGLES DO YOU AGREE? (Y/N) : : A:

•

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Figure 9. Display for Input of Number of Variable Vanes

ENTER LOUER BOUNDARY VALUE FOR VANE 1 (INCLUDE DECIMAL POINT) -10.000 LOUER BOUND FOR UANE 1 IS DO YOU AGREE? (Y/N)

Figure 10. Vane Setting Lower Bound Display

ENTER UPPER BOUNDARY VALUE FOR VANE 1 (INCLUDE DECIMAL POINT) 10.000 UPPER BOUND FOR UANE 1 IS DO YOU AGREE? (Y/N)

Figure 11. Vane Setting Upper Bound Display

6: 1: ENTER LOWER BOUND VALUE FOR SM 5. ENTER UPPER BOUND VALUE FOR SM 50.

Figure 12. Performance Constraint Bounds Display

1. 11 ENTER INITIAL UALUES FOR UANE ANGLES

O. INITIAL UALUE FOR UANE 1 - 0.0

DO YOU AGREE ? (Y/N)

VANE 2 - (INCLUDE DECIMAL POINT)

O. INITIAL UALUE FOR UANE 2 - 0.0

DO YOU AGREE ? (Y/N)

VANE 3 - (INCLUDE DECIMAL POINT)

OANE 4 - (INCLUDE DECIMAL POINT)

VUANE 4 - (INCLUDE DECIMAL POINT)

OANE 6 - (Y/N)

Santa San

Figure 13. Initial Vane Settings

ENTER INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTI

Figure 14. Incremental Vane Angle for Initial Sequence of Tests

0.0 DEGREES SET UANE 1 TO 1 # H 1

34

DEGREES 0.0 SET VANE 2 TO DEGREES 0.0 SET UANE 3 TO SET UANE 4 TO

DEGREES

9.9

A VALUE OF A VALUE OF CONSTANT AT HOLD RPMC HOLD DUS

0.0 1.0000

HAS FLUTTER OR EXCESSIVE VIBRATION OCCURRED AT THE REQUESTED POINT? (Y/N)

Figure 15. Vane and Compressor Rig Settings Display

A: ::

ENTER OBJECTIVE FUNCTION VALUE FOR EFFICIENCY 89.56

ENTER CONSTRAINT VALUE FOR SURGE MARGIN

EFFICIENCY= 89.5600 SURGE MARGIN= 10.0000

CORRECT ? (Y/N)

Figure 16. Measured Performance Parameters Input

Test		Vane Angle (deg)	gle (deg)		Bleed
Number	έ	42	143	**	Flow
1	0,	0	0	0	0
~	$0+\hat{\delta}^3$	0	0	0	0
ო	0+ŷ	0+0	0	0	0
4	0+ŷ	0+0	0+ů	0	0
ß	0+ŷ	0+0	%+ 0	0+0	0
ဖ	0+ŷ	0+0	0 + ٥	0+ŷ	0+134

Notes:

1. Number of Tests is N+1, Where N is the Number of Variable Vanes and Bleeds.

2. First Test Is Base, or Reference, Vane and Bleed Setting.

3. 8 is Operator Input of Incremental Vane Setting.

4. β is Operator Input of Incremental Bleed Flow

Figure 17. Initial Test Sequence

OPERATOR-IMPOSED CONSTRAINTS

During a test program, the operator will be monitoring a variety of strain gauge and blade flutter monitors. Any of these sensors may allow the operator to conclude that the test point vane settings may threaten the mechanical integrity of the compressor. Rejection of a test point should not automatically bring about the conclusion of the optimization attempts. The way to avoid this vane setting region (and discourage further movement in the hazardous direction) is by the artificial creation of a performance index deterioration or a constraint variable rise. A series of such actions by the operator will define to the program a wall or barrier that should not be crossed due to the optimum-seeking or constraint-avoidance logic. The technique employed in the vane optimization program is to change the performance index of the hazardous point by a factor of two. This is enacted by indicating that flutter or excessive vibration has occurred at the requested point.

STOPPING POINT

The stopping criteria used in this program include:

- 1. A minimum relative change in the objective function to indicate convergence
- 2. An absolute change in the objective function
- 3. A maximum number of iterations
- 4. Two consecutive approximate optimizations resulting in the same vane angle settings.

SECTION III

PROGRAM ORGANIZATION

GENERAL

The main program, as shown in Figure 18, consists simply of calls to the various subroutines used to initialize the input into the COPES/CONMIN optimization subroutine known as VOPT. Additionally, the main program contains logic for restarting the program at any point during the optimization. A description of each subroutine appears in the following paragraphs.

Subroutine PAGE1

Subroutine PAGE1 writes the title page to the screen and to the printer. The subroutine then waits until the operator depresses ENTER to go to subroutine GOAL.

Subroutine GOAL

Subroutine GOAL displays the listing of optimization goals and asks the operator to enter the value of the desired goal. It should be noted here that the value of the desired goal should be right adjusted in a two-column field. This means that numbers 1 through 9 should be entered as 01 through 09. Subroutine GOAL then writes to the screen the goal which the operator selected. When the operator is satisfied with the goal he has selected, subroutine GOAL then returns to the main program with the value of the desired goal.

Subroutine OPTCON

Subroutine OPTCON takes the value of the desired goal and prompts the operator for the necessary input to be used to write the COPES/CONMIN program input data.

Subroutine START

Subroutine START takes the initial X-vector and the number of design variables (NDV) and then creates NDV+1 X-vectors by perturbating the vane angles and bleed flow by some given amounts input by the operator. The subroutine writes these vectors into a file that will be read by COPES/CONMIN.

Subroutine SCFILE

Subroutine SCFILE takes all of the block data and all of the input from subroutine OPTCON and writes it into a file in right-adjusted fields of 10 columns each. COPES/CONMIN then reads this file in its optimization process.

Subroutine VOPT

Subroutine VOPT is the COPES/CONMIN optimization program.

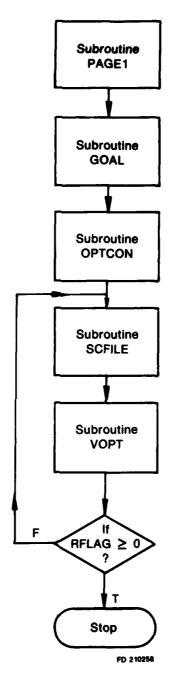


Figure 18. Program Organization

Subroutine ANALIZ

The COPES User's Manual (Reference 1) explains subroutine ANALIZ. An additional feature has been added to the usual ANALIZ output. When the program reaches a final solution, ANALIZ will write out the final results on the screen for the operator to see.

Subroutine ANALIZ includes a restart signal enabling the operator to restart the program without re-entering the data through subroutine OPTCON.

INITIALIZING INPUT-OUTPUT FILES

Before executing the vane optimization program, the user must allocate the following files:

File No.	Program Name	<u>Use</u>
5	ISCRX	Contains initial NDV+1 X-vectors
5	ISCRXF	Contains X-F pairs on a continuous basis
6	IPRINT	Output to printer
11	ISC	Scratch file which contains COPES/
		CONMIN input data
12	ISCR1	Scratch file used by COPES/CONMIN
		program
13	ISCR2	Scratch file used by COPES/CONMIN
		program
15	IREAD	Input from terminal
16	IWRITE	Output from terminal

All files, except File 13 (ISCR2) should contain the following attributes: Block size — 6160, logical record length — 80, and record format — fixed block. File 13 should contain the following: block size — 6160, logical record length — 85, and record format — variable block span. Figure 19 shows a sample procedure for initializing these input-output files.

ATTRIB NORK BLKSIZE(6160) LRECL(80) RECFM(F B) ATTRIB NORT BLKSIZE(6160) LRECL(85) RECFM(V B S) /* ALLOCATE DATASETS	00000030 00000032 00000040
/* FILE IREAD	00000050 00000060
ALLOC DD(FT15F001) DSN(*) REUSE	00000070
/* FILE IMPITE ALLCO DD(FT16F001) DSN(*) REUSE	00000080 00000090
/* FILE ISC	00000100
ALLOC DD(FT11F001) DSN('XXXXXXX.FILE.F11.DATA') NEW SP(1,1) TRACKS - USING(WCRK) REUSE	00000110 00000115
/* FILE ISCR1 ALLCC DD(FT12F001) DSN('XXXXXXX.FILE.F12.DATA') NEW SP(1.1) TRACKS -	00000120 00000130
USING(NORK) REUSE	00000135
/* FILE ISCR2 ALLOS DD(FT13F001) DSN('XXXXXXX.FILE.F13.DATA') NEW SP(1,1) TRACKS -	00000140 00000150
USING(WORT) REUSE	00000155
/* FILE IFRINT ALLOC DD(FT06F001) SYSOUT(&CLASS) REUSE	0000016 0 0000017 0
/* FILES ISCRY AND ISCRYF	03100000
ALLOC DD(FT05F001) DSH('XXXXXXX.FILE.F05.DATA') NEW SP(1,1) TRACKS - USING(NORK) REUSE	00000190 00000195

FD 210250

Figure 19. Initialization Procedure

SECTION IV

COPES/COMMIN DESCRIPTION

THEORY

CONMIN (Reference 2) represents a general purpose optimization program designed primarily for the optimization of constrained functions. The basic optimization algorithm used in CONMIN employs a direct search technique based on the method of feasible directions described in Reference 3. The algorithm has been modified to improve efficiency and numerical stability and to solve optimization problems in which one or more constraints are initially violated (Reference 4). In a subroutine format, CONMIN can be called by a user-supplied main program. The user should supply a main program containing the analysis, constraints, equations, and objective function. Therefore, if an existing analysis program is used, the analysis portion may need some reorganization, and constraint equations must be prepared in accordance with CONMIN requirements.

In order to eliminate this inconvenience, a control program known as COPES (a FORTRAN Control Program for Engineering Synthesis) was developed by the same author who developed CONMIN. COPES combined with CONMIN enables the use of CONMIN as a "black box" for optimization in automated design synthesis. The user need only provide a FORTRAN analysis program for the particular problem being considered. COPES simply calls the user-supplied program written according to a simple set of guidelines. The capabilities of COPES/CONMIN include:

- 1. Simple analysis
- 2. Optimization
- 3. Sensitivity analysis
- 4. Two-variable function space generation
- 5. Optimum sensitivity analysis
- 6. Approximate optimization.

Particularly, approximate optimization provides the most suitable technique for the compressor vane optimization problem where the number of test points needed to perform the optimization is a limiting factor. The basic idea of approximate optimization technique involves sequentially optimizing an approximate design function surface generated from available information. In this program, the design surface represents a function of efficiency and stall margin. At the end of the optimization, the design surface is updated with information from a precise analysis, or test, at a new set of design variables. This new approximate problem is then optimized, followed by a new precise analysis. This process repeats until the solution has converged.

COPES/CONMIN possesses the capability to do up to a second-order approximation. If excessive data are available, the extra data are applied to a weighted least-square fit, rather than in obtaining higher order approximations. If a quadratic design surface were assumed, the second-order approximation would be precise. If the problem at hand can be approximated by a quadratic function, this method becomes feasible.

An outline of the sequential approximation approach (Reference 5) appears below. The second-order approximate form comes from a Taylor series expansion of any function, noted as

$$\Delta f \simeq \nabla f \cdot \Delta \bar{x} + \frac{1}{2} \Delta \bar{x}^{T} [H] \Delta \bar{x} \tag{1}$$

where,

n = number of design parameters

x" = nominal design analyzed to yield f.

Equation 1 holds for both objective and constraints. The unknowns are:

$$\frac{\partial \mathbf{f}}{\partial \mathbf{x}_1} \dots \frac{\partial \mathbf{f}}{\partial \mathbf{x}_n}$$
 and $\frac{\partial^2 \mathbf{f}}{\partial \mathbf{x}_1^2} \dots \frac{\partial^2 \mathbf{f}}{\partial \mathbf{x}_n^2}$

for a total of $(\ell = n + n (n+1)/2)$. Since one analysis is required for the nominal design, a total of $(\ell+1)$ test points are required to determine the unknowns, (∇f) and [H]. If more than $(\ell+1)$ tests are available, a weighted least-square fit is used.

Since previous test data show that efficiency and stall margin can be closely approximated locally in quadratic form in terms of the vane angle, quadratic approximation in the compressor vane optimization is considered quite reasonable. The fact that analysis data obtained in one optimization are used to improve the design surface for subsequent optimization enables the test engineer to choose a new test point; i.e., the result obtained in one optimization becomes the recommended test point and the test result obtained at this point is added to the new approximate optimization problem.

Numerical experience shows that a full quadratic approximation is not necessarily required even when the design function surface is quadratic. An approximation that includes up to the diagonal terms of the Hessian matrix in Equation 1 is quite accurate for a quadratic surface. This approximation requires a minimum of 2n+1 test points (n tests for linear terms, n tests for diagonal terms of the Hessian matrix, and one test for the initial design point). If more than 2n+1 designs are available, they are used in a weighted least-square fit. The COPES/CONMIN program provides the user with the option to use the approximate design surface constructed using only up to the Hessian diagonal terms in the approximate optimization. Because this technique can significantly reduce the number of expensive test points without losing the quality of the solution, it is used in the compressor vane optimization.

INTERFACING REQUIREMENTS

The COPES/CONMIN computer program is set up to make multiple passes through a subroutine called ANALIZ. In the conventional design process, this subroutine will contain an evaluation of the performance index being optimized and the constraint parameter for a given set of vane angles. The vane optimization program logic will specify a new vane setting to the operator and take care of recording new data from operator entries in the proper format. Command will be transferred back to the program and execution will continue with the newly supplied information. The method of interfacing described above required the absolute minimum level of COPES/CONTIN code change.

Another very important interfacing objective is to reformat operator input data to be compatible with the existing COPES input handling routine COPE01. Again, the driving force behind this objective is the desire to retain as much of the original COPES code as possible.

The COPES User's Manual (Reference 1) contains a detailed description of the complete input file requirements for the full variety of deck options. Figure 20 presents a listing of the card images of input data relevant to the COPES/CONMIN approximate optimization logic within the compressor vane optimization program.

I5N 0002	BLOCK DATA	02001
TSN 0003	COMMON /BDATA/ NCALC, HSV, NOVAR, IPHPUT, IFDDG,	20002 20003
	1 IPRNT, ITMAX, NSCAL, ITFN, LINCOJ, NACHX1, NFDG,	00003
	2 FDCH, FDCHH, CT, CTHIN, CTL, CTLMIN, THETA,	00005
	3 DELFUN. DABFUN, ALPHAX, ACCOUIT,	00005
	4 NF, NXA, INCM, IPAFTX,	05307
	5 HEMAX, JNOM, INXLOC, INFLOC, MAXTRM	00007
ISN 0004	DATA NCALC. HSV, HCVAP, IFHFUT, IFDES,	00009
	1 IPENT, ITHAX, NSCAL, ITEM, LINCOJ, NACHXI, NFDG,	00000
	2 FOCH, FOCHM, CT, CTHIN, CTL, CTLMIN, THETA,	0:011
	3 DELFUN, DAEFUN, ALFWAX, AECBJ1,	00012
	4 NE, HKA, IHOM, IPAFRX,	00013
	5 NEMAX, JHOM, INYLOG, INFLOG, MAXTRM/	02014
	* 6,0,0,1,0,	00015
	1 5,20,0,3,0,0,0,	00016
	2 .01,.001,05,.004,01,.001,1.0,	00017
	3 .001,0.0,.1,.1,	00018
	4 0,0,0,1,	00019
	5 0.0.0,0,2/	00020
ISN 0005	COMMON /UNIT/IREAD, INRITE, IPRINT, ISCRX, ISCRXF, ISC	02021
ISN 0006	DATA IREAD, INCRITE, IPRINT, ISCRX, ISCRXF, ISC/15, 16.6.5,5,11/	00022
ISN 0007	COMMON /NAME/HAME(7)	0:023
ISN 0003	DATA NAME/4HRPMC.4HHC ,4HPR ,4HDVS ,4HOL ,4HSM ,4HEFF /	00024
		09025
ISN 0009	END	00025

Figure 20. COPES/CONMIN Input Data Relevant to the Compressor Vane Optimization Program

SECTION V

PROGRAM DEMONSTRATION

COMPRESSOR SIMULATION

In order to demonstrate the vane optimization software, a stage-by-stage compressor model has been implemented into a computer program. The characteristics of normalized pressure rise and temperature rise as functions of normalized airflow and vane angle are representative of an eleven stage, four variable vane compressor. The stall line used to provide the compressor performance appears in Figure 21. The illustrations shown in Figures 22 through 25 depict the efficiency and stall margin variations with vane angle computed at two degree increments, while holding speed and discharge area constant.

It should be noted that efficiency and stall margin calculations have an accuracy of $\pm 0.05\%$, which may be attributed to the following factors:

- 1. Stage characteristic modeling
- 2. Interpolations between stage characteristics
- Flow balance iterations.

Thus, the performance calculations from this model can be considered to have an inherent $\pm 0.05\%$ measurement error.

Input to the stage-by-stage compressor model is read using a FORTRAN-NAMELIST statement. Each input case must begin with \$PWA punched starting in Column 2 to prepare the program to read the input. The input then follows, punched in FORTRAN-NAMELIST format, with each item separated with a comma and with the input list concluded by \$END. No input may be entered in Column 1. The \$END card initiates execution. The input parameters are as follows:

Parameter	Default Value		Description
NIN	5		Input file number
NOUT	6		Output file number
NOUTN	0		Optional output file number
CASE*	0		Case number
VANE1	0		Vane angle 1
VANE2	0		Vane angle 2
VANE3	0		Vane angle 3
VANE4	0		Vane angle 4
STOP	0		Stop signal
WCINLT	Converged	81.5	Inlet corrected airflow
GUES	values from or	-	M-line guess
	previous	0.94	v
	case		

The converged values for the independent variables WCINLT and GUES from a successfully closed point can be used as guesses for the next point. If no guess is supplied by the user for the first run, the values 81.5 and 0.94 will be used as guesses for WCINLT and GUES, respectively. On succeeding points, if no guesses are given, the converged values from the last point are used. The M-line guess should be approximately 1.0.

^{*}CASE is automatically incremented with each set of input read, unless reloaded.

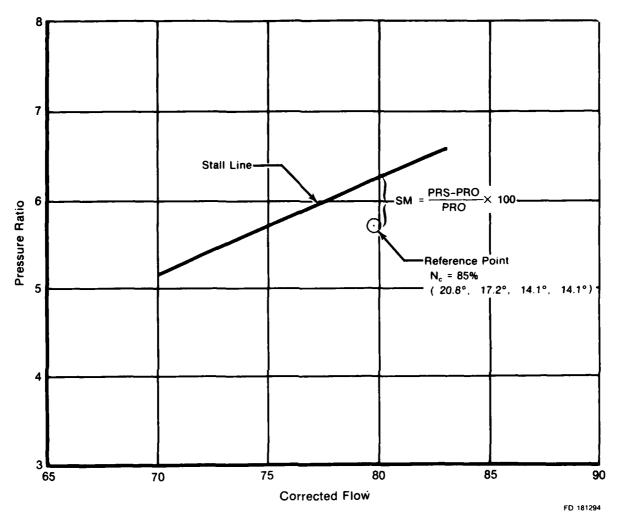


Figure 21. Compressor Model Performance Map

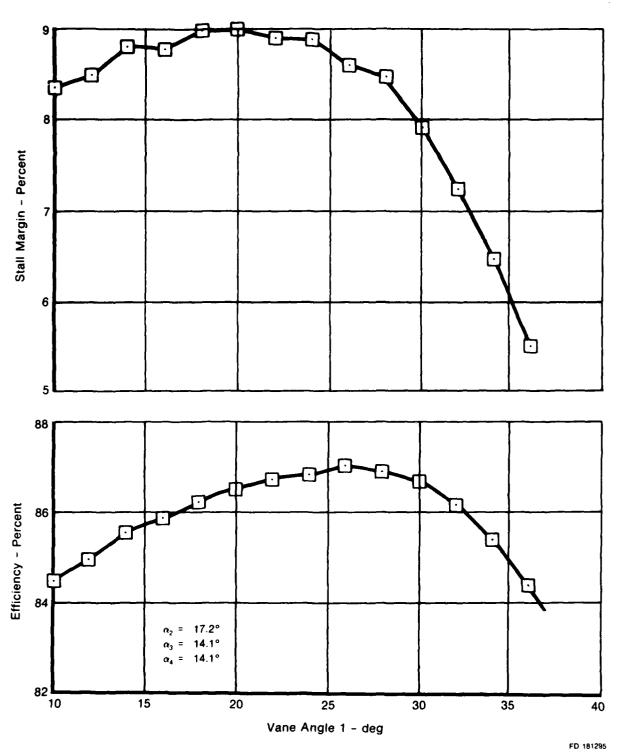
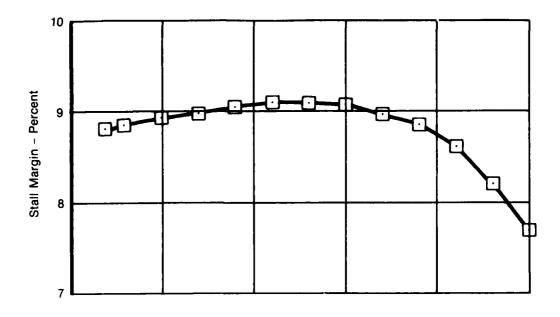


Figure 22. Efficiency and Stall Margin Variation With Variable Vane 1



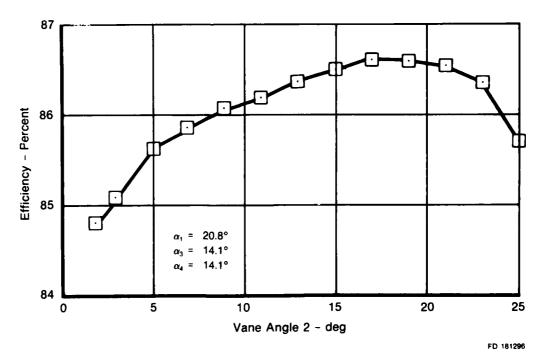
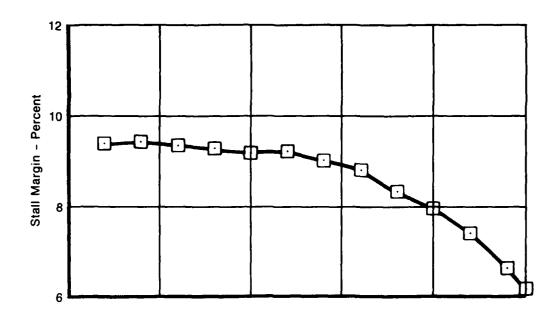


Figure 23. Efficiency and Stall Margin Variation With Variable Vane 2



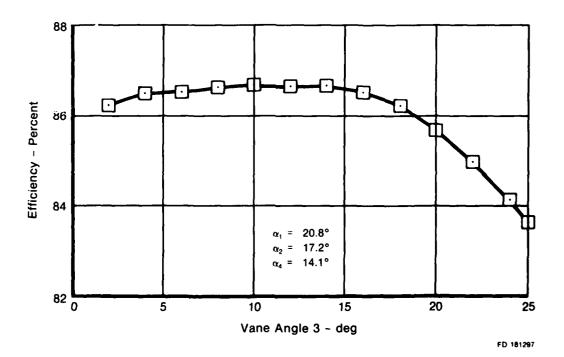
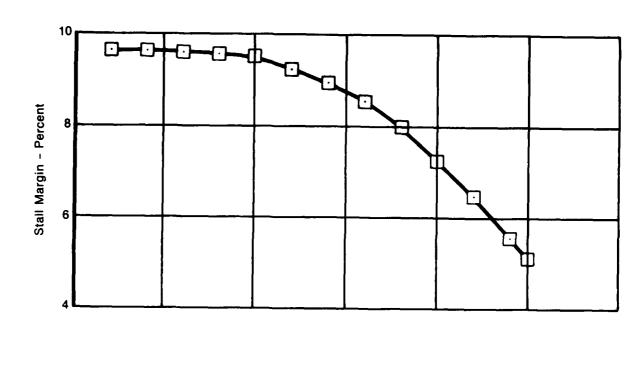


Figure 24. Efficiency and Stall Margin Variation With Variable Vane 3



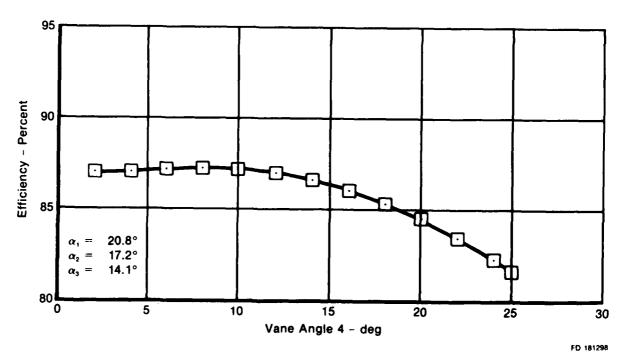


Figure 25. Efficiency and Stall Margin Variation With Variable Vane 4

All input is initially read and written to input files 5 and 6. However, the file number can be changed by the user by changing the input variables NIN and NOUT. It is also possible to direct the output to two different output files by specifying another file number NOUTN. If this variable is omitted, output will be directed to only one file, specified by NOUT. A STOP ≈ -1.0 should be included in the last input case to terminate the program. If it is left out or set to a value other than -1.0, the program will look for another input case to follow. The output parameters are:

Parameter	Description					
VANE1	Input vane angle 1					
VANE2	Input vane angle 2					
VANE3	Input vane angle 3					
VANE4	Input vane angle 4					
SM	Surge margin					
EFF	Adiabatic efficiency					
PR	Pressure ratio					
WC	Corrected airflow					

The following paragraphs detail the results for various optimization goals using the optimization program on the stage-by-stage compressor simulation. A summary of the problems solved and the resulting solutions is presented in Table 1. Appendices A through I contain output information for the sample problems.

UNCONSTRAINED OPTIMIZATION

Example 1:

The objective of this problem involves the optimization of four variable vanes for maximum efficiency, while holding speed and discharge area constant (Optimization Goal 1). The optimization problem can be formulated as

$$\max_{\alpha_1,\alpha_2,\alpha_3,\alpha_4} \eta(\alpha_1,\alpha_2,\alpha_3,\alpha_4, N, AREA)$$

$$\alpha_1,\alpha_2,\alpha_3,\alpha_4,N, AREA$$
(3)

subject to

a.
$$\alpha_{1_{\min}} \leq \alpha_{1} \leq \alpha_{1_{\max}}$$
 $\alpha_{2_{\min}} \leq \alpha_{2} \leq \alpha_{2_{\max}}$ $\alpha_{3_{\min}} \leq \alpha_{3} \leq \alpha_{3_{\max}}$ $\alpha_{4_{\min}} \leq \alpha_{4} \leq \alpha_{4_{\max}}$
b. AREA = AREA₀ = 76.779
c. N = N₀ = 5567.5 rpm (% Nc = 85)

The upper and lower bounds imposed on vane travel appear in Table 2.

With initial vane settings of $(\alpha)_1=29$ deg, $(\alpha)_2=18$ deg, $(\alpha)_3=15$ deg, and $(\alpha)_4=11$ deg, and initial efficiency of 87.14%, convergence to the optimum efficiency of 87.53% occurs in 15 tests (10 iterations). Optimum vane angle settings become $(\alpha)_1=25.59$ deg, $(\alpha)_2=17.99$ deg, $(\alpha)_3=12.17$ deg, and $(\alpha)_4=7.47$ deg. Note that the incremental vane angle variation used for the initial sequence of 5 tests is -2 deg. Appendix A details the optimization results for Example 1.

TABLE 1. SUMMARY OF OPTIMIZATION EXAMPLES SOLVED

Example Number	Optimization Goal	α,	a_2	a 3_	α,	Pressure Ratio	Corrected Flow (Wc)	Efficiency (%)	Stall Margin (%)	Test Point Number at Optimum
1	Maximize y	25.59	17.99	12.17	7.47	_	_	87.53	9.32	15
2	Maximize v	24.55	17.78	11.68	7.76	_	-	87.52	9.45	15
3	Maximize SM	18.94	10.71	5.00	5.00	_	_	86.73	10.30	22
4	Maximize y with SM≥10.0	23.73	15.58	7.29	5.37	-	-	87.39	10.00	10
5	Maximize 7 with SM≥10.0	22.64	14.72	9.24	5.00	_	-	87.38	9.98	15
6	Maximize SM with n≥87.3	22.34	14.54	8.87	5.00	_	_	87.32	10.09	21
7	Maximize Wc with n≥87.0 and SM≥8.5	20.08	10.31	5.85	5.00	-	84.39	86.81	10.19	14
8	Minimize Wc with n≥87.0 and SM≥8.5	27.93	19.92	15.72	9.54	_	77.65	87.20	8.47	15
9	Maximize PR with n≥87.0 and SM≥8.5	21.06	10.17	5.01	5.01	6.105	_	86.82	10.15	15

TABLE 2. VANE TRAVEL LIMITS

	α_1	α_2	α_3	α_4
Lower Bound	10	5	5	5
Upper Bound	35	25	25	25

Example 2:

This problem duplicates Example 1, except that the initial sequence is modified. Design of the example evaluates the effect of randomly selecting the initial test points.

With initial vane angles set at $(\alpha)_1=18$ deg, $(\alpha)_2=10$ deg, $(\alpha)_3=5$ deg, and $(\alpha)_4=5$ deg, and efficiency $(\eta)=86.60\%$, convergence occurs in 19 tests, although optimization was reached at the fifteenth test point. Optimum vane angles become $(\alpha)_1=24.55$ deg, $(\alpha)_2=17.78$ deg, $(\alpha)_4=11.68$ deg, and $(\alpha)_4=7.76$ deg at an efficiency of 87.52%. A 2 deg incremental vane angle variation was used for the initial sequence of tests in this example. Appendix B lists the optimization results for Example 2.

The fact that the optimum efficiency duplicates that found in the first example indicates that the analysis is relatively insensitive to starting point. The optimum vane angle settings, however, are slightly different for the two examples, although they are within 1 deg of each other. The compressor model exhibits a very flat region near the optimum with little gain in efficiency. This fact also attributed to the additional tests required in the second example to meet the convergence criteria after the optimum was reached.

Example 3:

The objective of Example 3 is to maximize stall margin while holding speed and discharge area constant (Optimization Goal 7). The problem can be expressed as

$$\max_{\alpha_1, \alpha_2, \alpha_3, \alpha_4} SM \tag{4}$$

With the same initial vane settings and initial test sequence as in Example 1, the optimum settings were obtained after 22 test points. The vane settings are $(\alpha)_1=18.94$ deg, $(\alpha)_2=10.71$ deg, $(\alpha)_3=5.00$ deg, and $(\alpha)_4=5.00$ deg with an optimum stall margin at 10.30%. The efficiency at these vane settings is 86.73%. Results for this problem appear in Appendix C.

CONSTRAINED OPTIMIZATION

Example 4:

The function maximized in Examples 1 and 2 is now solved with stall margin constrained above a given level (Optimization Goal 4). The stall margin at the optimum efficiency conditions in the previous examples are 9.32 and 9.45%, respectively. Mathematically, this problem can be stated as

max
$$\eta$$
 subject to SM $\geq 10.0\%$ (5)

With the same initial vane settings and initial test conditions as Example 1, a converged solution results in 14 tests at $(\alpha)_1=23.73$ deg, $(\alpha)_2=15.58$ deg, $(\alpha)_3=7.29$ deg, and $(\alpha)_4=5.37$ deg with an efficiency at 87.39% and stall margin of 10.00%. Note that the optimization algorithm brought the efficiency down from the 87.5% values in Examples 1 and 2 to meet the stall margin constraint. Appendix D presents the results for this example.

Example 5:

The same problem as Example 4 is considered, except that the influence of measurement error on convergence ability is examined. In addition to the $\pm 0.05\%$ noise in the stage-by-stage model, the random errors shown in Table 3 are added to the performance values. The errors are normally distributed with a standard deviation of 0.05.

Appendix E details the results for this example. The optimum was reached in 15 tests at $(\alpha)_1=22.64$ deg, $(\alpha)_2=14.72$ deg, $(\alpha)_3=9.24$ deg, and $(\alpha)_4=5.00$ deg with efficiency at 87.38% and stall margin at 9.98%. The efficiency and stall margin are essentially the same as the values obtained in Example 4 and the vane angles are within 2.0 deg.

Example 6:

This problem represents the constrained version of Example 3. Here, it is desired to maximize stall margin while maintaining efficiency above a given level (Optimization Goal 10). Mathematically, this can be represented as

max SM subject to
$$\eta \ge 87.3\%$$
 $\alpha_1, \alpha_2, \alpha_3, \alpha_4$
(6)

Appendix F details the results of this optimizaton with start settings for vane angle as in Example 3. The optimum solution was reached after 21 tests at vane settings of $(\alpha)_1=22.34$ deg, $(\alpha)_2=14.54$ deg, $(\alpha)_3=8.87$ deg, and $(\alpha)_4=5.00$ deg with an optimum stall margin of 10.09% and an efficiency of 87.32%. Here, the optimization algorithm brought the stall margin down from 10.30% obtained in Example 3 to meet the efficiency constraint.

TABLE 3. MEASUREMENT ERRORS FOR EXAMPLE 5

Test Point Number	Efficiency Error (%)	Stall Margin Error (%)
1	0.04	-0.04
2	-0.02	0.04
3	-0.03	0.09
4	0.03	-0.02
5	0.09	0.06
6	-0.02	-0.08
7	0.00	0.04
8	-0.06	0.00
9	0.01	0.01
10	0.02	0.00
11	0.06	0.08
12	0.02	0.00
13	-0.33	0.07
14	-0.04	-0.02
15	0.02	0.07
16	0.11	-0.01
17	0.01	-0.03
18	0.07	-0.02
19	-0.04	-0.06
20	0.05	-0.05
21	0.08	0.03
22	-0.03	0.04

Example 7:

The next two examples establish the maximum and minimum flow points to provide the maximum flow range. In addition to airflow requirements, performance constraints of minimum acceptable efficiency and stall margin also define the flow range. Thus, their evaluations must be considered for each geometry setting. For this example, Optimization Goal 14 is defined as

max Wc with
$$\eta \ge 87.0\%$$
 and SM $\ge 8.5\%$ (7)

subject to the conditions of holding speed constant at 5567.5 rpm and discharge valve area at 76.779.

Appendix G details the results. For the initial test sequence used in Examples 1 and 3 through 6, the optimization algorithm converged to the maximum flow in 14 tests at a corrected flow of 84.39 lbm/sec with an efficiency of 86.81% and stall margin of 10.19%. Optimum vane settings are $(\alpha)_1=20.08$ deg, $(\alpha)_2=10.31$ deg, $(\alpha)_3=5.85$ deg, and $(\alpha)_4=5.00$ deg.

Example 8:

This example deals with minimizing corrected airflow (Optimization Goal 15), mathematically formulated as

min Wc with
$$\eta \ge 87.0\%$$
 and SM $\ge 8.5\%$ (8)

subject to holding speed and discharge area constant.

Results for this example appear in Appendix H. With the same initial test sequence as in Example 7, the minimum corrected airflow of 77.65 lbm/sec was reached in 15 tests at $(\alpha)_1=27.93$ deg, $(\alpha)_2=19.92$ deg, $(\alpha)_3=15.72$ deg, and $(\alpha)_4=9.54$ deg with an efficiency of 87.20% and stall margin of 8.47%.

Example 9:

As a final example, the pressure ratio is maximized at constant speed and discharge area while maintaining minimal acceptable values of efficiency and stall margin (Optimization Goal 17). The problem solution can be stated as

max PR with
$$\eta \ge 87.0\%$$
 and SM $\ge 8.5\%$ (9)

Results of performing the optimization appear in Appendix I. This example converged in 15 tests at a maximum pressure ratio of 6.105 with an efficiency of 86.82% and stall margin of 10.15%. The optimum vane settings are $(\alpha)_1=21.06$ deg, $(\alpha)_2=10.17$ deg, $(\alpha)_3=5.01$ deg, and $(\alpha)_4=5.01$ deg.

SECTION VI

IDENTIFICATION

Pratt & Whitney Aircraft Group, Government Products Division uses a "Customer Computer Deck" identification system that appears on the outline sheet as

CCD XXXX-XX.X DATE XX/XX/XX

The first four digits correspond to the compressor vane and bleed optimization program. If another optimization method is developed or studied which does not replace or supercede the original method, a new four-digit number will be used.

Changes in the demonstrator compressor model performance will be related in different dash numbers. The dash number of the original deck will be zero.

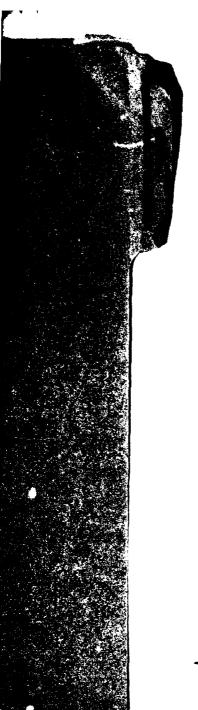
The decimal number will be used to reflect all deck changes which do not affect the basic optimization method or compressor model. This includes correcting any program errors.

Any deck change causing a change to the dash number or decimal part of the CCD number will change the previous date of the deck.

PERSONAL PARK MARK-HOR PLUMS

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STATOR VANE OPTIMIZER

PROTOTYPE_SOFTWARE_CAPABLE_OF_GUIDING_THE_OPTIMIZATION_OF_

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

BY: PRATT & WHITNEY AIRCRAFT GROUP GOVERNMENT FRODUCTS DIVISION

PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU

Ю	I	GOAL						TIONS					
1	ľ	EFF	I	X	-	-	X	-	I	-	Ī	-	ī
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3	I	EFF	I	-	X	X	-	-	I	-	I	-	I
4	I	EFF	I	X	-	-	X	-	I	MIN	I	-	I
5	I	EFF	I	X	-	-	-	Х	I	MIN	I	-	I
6	Î	EFF	Ī		X	×	-	**	ľ	MIN	Ī	-	1
7	I	S.M.	I	X	-	-	Х	-	I	-	I	-	I
8	I	S.M.	I	X	-	-	-	X	I	-	I	-	I
9	I	S.M.	I	-	X	Х	-	-	I	_	I	-	I
10	ľ	s.n.	Ī	×		-	x_		I		I	MIN	I
11	I	s.n.	I	X	-	-	-	X	I	-	I	MIN	I
12	I	S.M.	I	-	X	X	-	-	I	-	I	MIN	I
13	I	SM/BLD		X	X	-	-	-	I	-	I	-	I
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CORRECTED SPEED (RPMC) AND DISCHARGE VALVE SETTING (DVS) CONSTANT

WITH NO CONSTRAINTS ON SURGE MARGIN HOLD RPMC CONSTANT AT 5567.500 HOLD DVS CONSTANT AT 76.779 OPTIMIZING 4 VANE ANGLES LONER BOUND FOR VANE I IS 10.000 DO YOU AGREE? (Y/N) LOHER BOUND FOR VANE 2 IS 5.000 DO YOU AGREE? (Y/N) LCHER EQUID FOR VANE 3 IS 5.000 DO YOU AGREE? (Y/N) LOMER EQUND FOR VANE 4 IS 5.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE TIS 35.000 DO YOU ACREES (Y/N) UPPER BOUND FOR VANE 2 IS DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 3 IS 25.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VALLE 4 IS 25.000

DO YOU ACREE? (Y/N) INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTING IS

RAMETERS; N CONTROL, GLOBAL DESIG SENSITIVITY FUNCTIONS IN APPROXIMATION RMATION FRIN T CODE,	N VARIABLE	ES, NO	.C =	6	
GLOBAL DESIG SENSITIVITY FUNCTIONS IN APPROXIMATIN RMATION FRIN	N VARIABLE	ES, NO		6	
SENSITIVITY FUNCTIONS IN APPROXIMATIN RMATION FRIN	VARTARIES	NG	NV -	Ă	
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		IPDE	:s =	0	
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					0
FDCHM	1	СТ		CTM	0 In
FDCHM 01 0.100	1 00E-02	CT -0.5000	0E-01	CTM: 0.4	0 IN 0000E-02
FDCHM 01 0.100	1 00E-02	CT -0.5000	0E-01	CTM: 0.4	0 IN 0000E-02
FDCHM 01 0.100	1 00E-02	CT -0.5000	0E-01	CTM: 0.4	0 IN 0000E-02
FDCHM 01 0.100 CTLHI 01 0.100	N 00E-02	CT -0.5000 THETA 0.1000	0E-01 0E+01	CTM: 0.4	0 IN 0000E-02
FDCHM 01 0.100 CTLHI 01 0.100	N 00E-02	CT -0.5000 THETA 0.1000	0E-01 0E+01	CTM 0.4 FHI 0.0	0 IN 0000E-02
FDCHM 01 0.100 CTLM1 01 0.100 DABFU 0.0	00E-02 N 00E-02	CT -0.5000 THETA 0.1000	0E-01 0E+01	CTM 0.4 FHI 0.0	0 IN 0000E-02
01 0.100 CTLHY 01 0.100 DABFU 02 0.0 IABLE INFORM	00E-02 N 00E-02	CT -0.5000 THETA 0.1000 ALPHAX 0.1000	0E+01 0E+01	FHI 0.4 0.0 ABC	0 IN 0000E-02
FDCHM 01 0.100 CTLM 01 0.100 DASFU 0.0 IABLE INFORM NITIAL VALUE	OOE-O2	CT -0.5000 THETA 0.1000 ALPHAX 0.1000	0E+01 0E+00	FHI 0.4 FHI 0.0 ABC	0 IN 0000E-02
FDCHM 01 0.100 CTLHI 01 0.100 DABFU 0.0 IABLE INFORM NITIAL VALUE LCHER	N 00E-02 N ATION HILL OVER	CT -0.5000 THETA 0.1000 ALPHAX 0.1000	OE+O1 OE+O0 ODULE	FHI 0.4 FHI 0.0 ABC 0.1	0 IN 0000E-02 BJ1 0000É+00
FDCHM 01 0.100 CTLHI 01 0.100 DABFU 0.0 IABLE INFORM NITIAL VALUE LCHER	N 00E-02 N ATION HILL OVER	CT -0.5000 THETA 0.1000 ALPHAX 0.1000	OE+O1 OE+O0 ODULE	FHI 0.4 FHI 0.0 ABC 0.1	0 IN 0000E-02 BJ1 0000É+00
FDCHM 01 0.100 CTLMI 01 0.100 DABFU 0.0 IABLE INFORM NITIAL VALUE LCHER BCUND 10000E+02 50000E+01	N 100E-02 N 100E-02 N ATICN HILL OVER UPFER BOUND 0.35000E- 0.25000E-	CT -0.5000 THETA 0.1000 ALPHAX 0.1000 R-RIDE M	OE+01 OE+00 ODULE INITIAL VALUE .2700001	CTM 0.40 FHI 0.00 ABC0 0.10 INPUT	0 IN 00000E-02 BJ1 0000É-00
FDCHM 01 0.100 CTLHI 01 0.100 DABFU 02 0.0 IABLE INFORM NITIAL VALUE LCHER BGCU: D 10000E+02 50000E+01 50000E+01	N OOE-02 N OOE-02 N MILL OVER UPPER BOUND 0.35000E 0.25000E	CT -0.5000 THETA 0.1000 ALPHAX 0.1000 R-RIDE M	0E+01 0E+00 0E+00 0E+00 1NITIAL VALUE .27000E .16000E	CTM 0.40 FHI 0.00 ABC0 0.10 INPUT	0 IN 00000E-02 BJ1 0000E+00
FDCHM 01 0.100 CTLMI 01 0.100 DABFU 0.0 IABLE INFORM NITIAL VALUE LCHER BCUND 10000E+02 50000E+01	N OOE-02 N OOE-02 N MILL OVER UPPER BOUND 0.35000E 0.25000E	CT -0.5000 THETA 0.1000 ALPHAX 0.1000 R-RIDE M	0E+01 0E+00 0E+00 0E+00 1NITIAL VALUE .27000E .16000E	CTM 0.40 FHI 0.00 ABC0 0.10 INPUT	0 IN 00000E-02 BJ1 0000É-00
FDCHM 01 0.100 CTLMI 01 0.100 DABFU 02 0.0 IABLE INFORM NITIAL VALUE LCHER BCUND 10000E+01 50000E+01 50000E+01	N 100E-02 IN ATION HILL OVER UPFER BOUND 0.35000E- 0.25000E- 0.25000E-	CT -0.5000 THETA 0.1000 ALPHAX 0.1000 R-RIDE M	0E+01 0E+00 0E+00 0E+00 1NITIAL VALUE .27000E .16000E	CTM 0.40 FHI 0.00 ABC0 0.10 INPUT	0000E-02 BJ1 0000E+00 SCALE 0.0
FDCHM 01 0.100 CTLM1 01 0.100 DABFU 02 0.0 IABLE INFORM NITIAL VALUE LCHER BCU: D 10000E+02 50000E+01 50000E+01 50000E+01	N 100E-02 IN ATION HILL OVER UPFER BOUND 0.35000E- 0.25000E- 0.25000E-	CT -0.5000 THETA 0.1000 ALPHAX 0.1000 R-RIDE M +02 0 +02 0 +02 0	0E+01 0E+00 0E+00 0E+00 1NITIAL VALUE .27000E .16000E	CTM 0.40 FHI 0.00 ABC0 0.10 INPUT	0 IN 00000E-02 BJ1 0000E+00
FDCHM 01 0.100 CTLMI 01 0.100 DABFU 02 0.0 IABLE INFORM NITIAL VALUE LCHER BCUND 10000E+01 50000E+01 50000E+01	N 100E-02 IN ATION HILL OVER UPFER BOUND 0.35000E- 0.25000E- 0.25000E-	CT -0.5000 THETA 0.1000 ALFHAX 0.1000 R-RIDE M +02 0 +02 0 +02 0 +02 0	0E+01 0E+00 0E+00 0E+00 1NITIAL VALUE .27000E .16000E	CTM 0.40 FHI 0.00 ABC0 0.10 INPUT	00000E-0 BJ1 00000E+0 SCAL 0.0 0.0
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* * !	APPROXI	MATE ANALYSI	S/OPTIMIZATIO	ON IN	FORMATION	
			ROXIMATED, N	-	0	
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READ	UNIT F	CR X-F PAIRS	ISCRX	· -=	5	
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MULTI	TRITER	C'I BELY.	YEACT!) = (
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GLOBA GLOBA X-VEC NUMBE 0.290	AL LCCA L CTCRS I ER 1 CCE+02	TICHS OF X-V 3 4 TIONS OF FUN NPUT FROM UN DESIGN 0.1800E+02	CTIONS IT 5 0.1500E+02	0.110	D0E+02	
GLOBA GLOBA X-VEC NUMBE 0.290 NUMBE 0.270	AL LCCA CTCRS I ER 1 CCE+02 ER 2 OOE+02	TICHS OF X-V 3 4 TIONS OF FUN NPUT FROM UN DESIGN 0.1600E+02 DESIGN 0.1800E+02	CTIONS O.1500E+02	0.110	D0E+02	
GLOBA GLOBA 7 X-VEC NUMBE 0.290 NUMBE	AL LCCA L 2 AL LCCA TOTORS I ER 1 CCE+02 ER 2 OOE+02 ER 3	TICHS OF X-V 3 4 TIONS OF FUN NPUT FROM UN DESIGN 0.1800E+02 DESIGN 0.1800E+02	CTIONS O.1500E+02	0.110	00E+02	

NUMBER 5 0.2700E+02 0.1		5 1300E+02	0.9000E+01	
* * ESTIMATED C	ATA_STORAGE	_REQUIREME	NTS	
REAL INPUT EXECUTIO 33 315	N AVAILABI 5000	E INFU	INTEGER T EXECUTION 64	AVAILABLE 1000
********	********	*****		
SET_VANE_1_TO_	29.00 DEGF	EES		
SET VANE 2 TO	18.00 DEGF	EES	·	
SET VANE 3 TO	15.00 DEG	EES		
SET VANE 4 TO	11.00 DEG	EES		
HOLD RPMC CONST	ANT AT A VA	LUE OF	5567.500	
HOLD DYS CONST EFFICIENCY=	ANT AT A VA	LUE OF	76.779	
*******		****		
*******	******	****		
SET VANE 1 TO	27.00 DEGR	EES		
SET VANE 2 TO	18.00 DEGR	EES		
SET VANE 3 TO	_15.00 DEG	EES		
SET VANE 4 TO	11.00 DEG	EES		
HOLD RENC CONST	ANT AT A VA	LUE OF	5567.500	
EFFICIENCY=			76.779	

SET_VANE_1_TO27.00 DEGREES		
SET VANE 2 70 16.00 DEGREES		
SET VANE 3 TO 15.00 DEGREES		
SET VANE 4 TO 11.00 DEGREES		<u>, </u>
HOLD RPMC CONSTANT AT A VALUE OF	5567.500	
HOLD DVS CONSTANT AT A VALUE OF EFFICIENCY= 87.2400	76.779	

SET VANE 1 TO 27.00 DEGREES		
SET VAILE 2 TO 16.00 DEGREES		
SET VAME 3 TO 13.00 DEGREES		
SET VANE 4 TO 11.00 DEGREES		
HOLD REMC CONSTANT AT A VALUE OF HOLD DVS CONSTANT AT A VALUE OF	76.779	
EFFICIENCY= 87.2000		

SET VANE 1 TO 27.00 DEGREES		
SET VANE 2 TO 16.00 DEGREES		
SET VANE 3 TO 13.00 DEGREES		
SET VANE 4 TO 9.00 DEGREES		
HOLD REMC CONSTANT AT A VALUE OF	5567.500	
HOLD DVS CONSTANT AT A VALUE OF EFFICIENCY= 87.3300	76.779	
养姜沙子英子产夫妻养养女子教徒教徒教徒教徒女子仁代女弟亲女女女女		

APPROXIMATE OPTIMIZATION ITERATION HISTORY

APPROXIMATING FUNCTION 1 THE OBJECTIVE
DESIGN VARIABLE NUMBERS ASSOCIATED WITH APPROXIMATING VARIABLE 1 2 3 4
BEGIN ITERATION NUMBER 1
NOMINAL DESIGN NUMBER = 5
X-VECTC: 0.27000E+02 0.16000E+02 0.13000E+02 0.90000E+01
FUNCTION VALUES 0.87330E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.20000E+01 0.20000E+01 -0.20000E+01 -0.20000E+01
X-VECTOR 0.25000E+02 0.18000E+02 0.11000E+02 0.70000E+01
APPROXIMATE FUNCTION VALUES
0.87680E+02 ****##*******************************
SET VANE 1 TO 25.00 DEGREES
SET VANE 2 TO 18.00 DEGREES
SET VANE 3 TO 11.00 DEGREES
SET VANE 4 TO 7.00 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.5200

PRECISE FUNCTION VALUES 0.87520E+02
•
BEGIN ITERATION NUMBER 2

_	0.25000E+02 0.18000E+02 0.11000E+02 0.70000E+01
	UNCTION VALUES
•	0.87520E+02
_	
R	ESULTS OF APPROXIMATE OPTIMIZATION
0	ELTA-X VECTOR
_	0.75337E+00 0.20000E+01 -0.20000E+01 -0.20000E+01
v	-VECTOR
_^	0.25753E+02 0.20000E+02 0.90000E+01 0.50000E+01
	FFROXIMATE FUNCTION VALUES
^	0.87701E+02
**	*****
S	ET VANE 1 TO 25.75 DEGREES
5	ET VANE 2 TO 20.00 DEGREES
S	ET VANE 3 TO 9.00 DEGREES
S	ET VANE 4 TO 5.00 DEGREES
	OLD RPMC CONSTANT AT A VALUE OF 5567.500
	CLO DVS CONSTANT AT A VALUE OF 76.779 FFICIENCY= 87.2800
**	*******************
F	RECISE FUNCTION VALUES
	0.87280E+02
В	EGIN ITERATION NUMBER 3
_	
N	CMINAL DESIGN NUMBER = 7
X	-VECTOR
	0.25753E+02 0.20000E+02 0.90000E+01 0.50000E+01
F	UNCTION VALUES
	0.87230E+02

DELTA-X VECTOR -0.52557E-03 -0.10725E-04 -0.77730E-06	-0.97167E-06
X-VECTOR 0.25753E+02 0.20000E+02 0.90000E+01	0.50000E+01
APPROXIMATE FUNCTION VALUES	
0.87280E+02	
预销预分泌外处验外外的现代分泌的原则的现代的现代的现代的现代的现代的	
SET VANE 1 TO 25.75 DEGREES	
SET VANE 2 TO 20.00 DEGREES	
SET VANE 3 TO 9.00 DEGREES	
SET VANE 4 TO 5.00 DEGREES	
HOLD RPMC CONSTANT AT A VALUE OF 55	67.500
HOLD DVS CONSTANT AT A VALUE OF	76.779
EFFICIENCY= 87.2800	

PRECISE FUNCTION VALUES	
0.87280E+02	
BEGIN ITERATION NUMBER 4	
MONTHAL PROTON ARPERTS - 0	
NCHINAL DESIGN NUMBER = 8	
X-VECTCR	
0.25753E+02 0.20000E+02 0.90000E+01	0.50000E+01
FURCTION VALUES	
0.8723CE+02	
RESULTS OF AFFROXIMATE OPTIMIZATION	
DELTA_V VECTOR	
DELTA-X VECTOR -0.14439E+01 -0.23921E+01 0.30000E+01	0.0
	
X-VECTOR	0 600006+03
0.24309E+02 0.17608E+02 0.12000E+02	0.5000000101
APPROXIMATE FUNCTION VALUES	
0.87600E+02	

SET VANE 1 TO 24.31 DEGREES SET VANE 2 TO 17.61 DEGREES SET VANE 3 TO 12.00 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD RPMC CONSTANT AT A VALUE OF HOLD DVS CONSTANT AT A VALUE OF 5567.500 76.779 EFFICIENCY= 87.4500 ******** PRECISE FUNCTION VALUES 0.87450E+02 BEGIN ITERATION NUMBER NOMINAL DESIGN NUMBER = 9 0.24309E+02 0.17608E+02 0.12000E+02 0.50000E+01 FUNCTION VALUES 0.87450E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR 0.15768E+01 -0.25826E+00 -0.30000E+01 0.61882E+00 0.25836E+02 0.17350E+02 0.90000E+01 0.56188E+01 APPROXIMATE FUNCTION VALUES 0.87683E+02 SET VANE 1 TO 25.89 DEGREES SET VANE 2 TO 17.35 DEGREES SET VANE 3 TO 9.00 DEGREES SET VANE 4 TO 5.62 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF ____76.779_ EFFICIENCY= 87.3900 ************

	i inner		
BEGIN ITERATION	A NOTIBER C	·	
NOMINAL DESIGN	NUMBER =	10	
X-VECTOR			
0.25836E+02	0.17350E+02	0.90000E+01	0.56188E+01
FUNCTION VALUES 0.87390E+02	5 		
RESULTS OF APPE	ROXIMATE OPT	IMIZATION	
DELTA-X VECTOR			
-0.10000E+01	0.59856E+00	0.10000E+01	0.10000E+01
X-VECTOR			
	0.17948E+02	0.10000E+02	0.66188E+01
APPROXIMATE FUI 0.87507E+02			
*********	· * * * * * * * * * * * * * * * * * * *	****	
SET VANE 1 TO	24.89 DEGRI	EES	
SET VANE 2 TO	17.95 DEGR	EES	
SET VANE 3 TO	10.00 DEGRE	ES	
SET VARE 4" TO	6.62 becne	EES	
HOLD REMC CONST	FANT AT A VAI	LUE OF 55	567.500
HOLD DVS CONS			76.779
EFFICIENCY=	07.5000		
	******	****	

0.87500E+02

NOMINAL DESIGN	NUMBER = 1	1	
X-VECTOR			
0.24836E+02	0.17948E+02	0.10000E+02	0.66188E+01
FUNCTION VALUE	S		
0.87500E+02			
RESULTS OF APP	ROXIMATE OPTI	MIZATION	
DELTA-X VECTOR			
-0.19008E+01		0.15271E+01	0.16999E+01
X-VECTOR			
0.22986E+02	0.17966E+02	0.11527E+02	0.85188E+01
APPROXIMATE FU	NCTION VALUES		
0.37574E+02		ww	
**************************************	******	***	
SET VANE 1 TO	22.99 DEGRE	ĖS	
SET VANE 2 TO	17.97 DEGRE	£3	
SET VANE 3 TO	II.53 BEGRE	ES	
SET VANE 4 TO	8.52 DEGRE	ES	
HOLD BENC CONS	TANT AT A VAI	III OF 55	67.500
HOLD DVS CONS			76.779
EFFICIENCY=	87.3600		
¥ *** *********	***********	****	
PRECISE FUNCTI 0.87360E+02	ON VALUES		
BEGIN ITERATIO	N NUMBER 6		
NOMINAL DESIGN	NUMBER = 1	2	
X-VECTOR		0.11527E+02	

FUNCTION VALUES 0.87360E+02

	RESULTS OF APPROXIMATE OPTIMIZATION
	DELTA-X VECTOR
	0.26762E+01 0.27435E-01 0.74201E+00 -0.10959E+01
	X-VECTOR
	0.25662E+02 0.17994E+02 0.12269E+02 0.74228E+01
-	APPROXIMATE FUNCTION VALUES
	0.87536E+02
	被整体的现在分词
	SET VANE 1 TO 25.66 DEGREES
_	SET VANE 2 TO 17.99 DEGREES
_	SET VANE 3 TO 12.27 DEGREES
	SET VANE 4 TO 7.42 DEGREES
_	HOLD RPMC CONSTANT AT A VALUE OF 5567.500
	HOLD DVS CONSTANT AT A VALUE OF 76.779
	EFFICIENCY= 87.5300

	PRECISE FUNCTION VALUES 0.87530E+02
	BEGIN ITERATION NUMBER 9
	HOMENAL DESIGN NUMBER = 13
	X-VECTOR
_	0.25662E+92 0.17994E+02 0.12269E+02 0.74228E+01
	FUNCTION VALUES
	0.87530E+C2
_	RESULTS OF APPROXIMATE OPTIMIZATION
	DELTA-X VECTOR
_	-0.72962E-01 -0.20336E-03 -0.94522E-01 0.48190E-01
	X-VECTOR
	0.25539E+02 0.17994E+02 0.12175E+02 0.74710E+01

APPROXIMATE FUNCTION VALUES
0.87530E+02 ************************************
THE PROPERTY OF THE PROPERTY O
SET VANE 1 TO 25.59 DEGREES
SET VANE 2 TO 17.99 DEGREES
SET VANE 3 TO 12.17 DEGREES
SET VANE 4 TO 7.47 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIENCY= 87.5300
菏光芳芳光瓷头梅芳式酱瓷瓷烤菜芳葵芙蓉袋 法莫提及施施托姆被提供养
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FRECISE FUNCTION VALUES
0.87530E+02
RICTH TIEDATION MARED 10
BEGIN ITERATION NUMBER 10
NCMINAL DESIGN NUMBER = 14
W HERTOR
X-VECTCR 0.25539E+02 0.17994E+02 0.12175E+02 0.74710E+01
VI003070102 VI0177712102 VI018102 VI717102102
FUNCTION VALUES
0.87530E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.27530E-02 -0.53158E-03 -0.88454E-03 0.12517E-02
0.275502-02 -0.551502-05 -0.004542-05 0.125172-02
X-VECTOR
0.25591E+02 0.17993E+02 0.12174E+02 0.74722E+01
APPROXIMATE FUNCTION VALUES
0.87530E+02

SET VANE 1 TO 25.59 DEGREES
OUT THIS 2 TO ESTAS DEGREES
SET VANE 2 TO 17.99 DEGREES

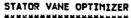
SET TARE S TO LELLY SCOREES
SET VANE 4 TO 7.47 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.5300

PRECISE FUNCTION VALUES 0.87530E+02
FINAL RESULT OF APPROXIMATE OPTIMIZATION
NOMINAL DESIGN NUMBER = 15
X-VECTC? 0.25591E+02 0.17993E+02 0.12174E+02 0.74722E+01
FUNCTION VALUES 0.07530E+02
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION
TITLE ************************************
GLOBAL LOCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X) 7
APPROXIMATION IS BASED ON 15 DESIGNS
NOMINAL DESIGN IS DESIGN NUMBER 15
VALUES OF X-VARIABLES 0.2559E+02 0.1799E+02 0.1217E+02 0.7472E+01
VALUES OF FUNCTIONS, F(X) 0.8753E+02
COEFFICIENTS OF TAYLOR SERIES EXPANSION
PARAMETER 1 = GLOBAL VARIABLE 7
LINEAR TERMS, DEL F 0.1770E-03 -0.2815E-04 -0.7172E-04 0.1071E-03

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NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT

RC:1 -0.43	1 33E-01				
RCH :					
ROH :	_				
RCH (88E-01 4 63E-01				
OPTIMIZ/	ATION RES	SULTS			
	VE FUNCTI LOCATION		NCTION VALUE 0	.87530E+02	
DESIGH '	VARIABLES				
10	0. V. KO. 1	GLOBAL VAR. NO. 1		VALUE _ 0.25591E+02	UFPER BCUND 0.35000E+0
2 3 4	2 3 4	2 3 4	0.50000E+01 0.50000E+01 0.50000E+01	0.17993E+02 0.12174E+02	0.2500CE+C
******	* FINAL	. SOLUTION V	ALUES *****		
VANE AND	SLE FOR V	ANE 1 IS	25.59 DE	GREES	
VALLE AND	SLE FOR V	ANE 2 IS	17.99 DE	GREES	
VAHE ANS	SLE FOR V	ANE 3 IS	12.17 DE	GREES	
VANE AND	SLE_FOR_V	ANE 4 IS	7.47 DE	GREES	
EFFICIEN	CY=	87.5300			
		NSTANT AT_			
REMC HAS	S HELD CO S HELD CO	ONSTANT AT ONSTANT AT	5 56 7.5 0 76.78		
	1 15				
7	12				



PROTOTYPE_SOFTWARE_CAPABLE OF GUIDING THE OPTIMIZATION OF__ STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR FREPARED FOR THE AIR FORCE AERO PROFULSION LABORATORY UNDER CONTRACT F33615-79-C-2013 BY: PRATT & MHITNEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU I OPTIMIZATION CONDITIONS I CONSTRAINTS I NO I GOAL I RENC MC FR DVS O.L. I S.M. I EFF I 1 1 **EFF** I X EFF 2 I X 3 I EFF I Х Х I I I MIN 4 I EFF I X X 5_I EFF I I MIN ĒFF 6 I X I MIN 7 I S.M. X T 8 I S.M. IX I 9 I S.M. 10 I S.H. 1 11 I S.M. I I MIN 12 I S.M. Х I MIN 1 13 I SH/BLD I I 14 I H'X KC I I MIN I MIN I 15 I MIN KC I х I MIN I MIN I 16 I FR X I MIN I MIN 17 I F3 I X I MIN I MIN YOU HAVE SELECTED TO OPTIMIZE EFFICIENCY HOLDING COMPECTED SPEED (RPMC) AND DISCHARGE VALVE SETTING (DVS) CONSTANT HITH TO CONSTRAINTS ON SURGE HARGIN HOLD REAC CONSTANT AT 5567.500 HOLD DVS CONSTANT AT OPTIMIZING 4 VAME ANGLE(S) LOHER BOUND FOR VAME 1 IS 10.000 DO YOU AGREE? (Y/N) LOTER DOUND FOR VAME 2 IS 5.000 DO YOU AGREE? (Y/N) 'LONIR ECUID FOR VANETS IST 5.000 DO YOU AGREE? (Y/N) LOWER DOUBD FOR VANE 4 IS 5.000 DO YOU AGREE? (Y/N) "UFFER BOUND FOR VANE 1" IS" 35.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VAME 2 IS 25.000 "DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 3 IS 25.000 DO YOU AGREE? (Y/N) UPPER DOUBD FOR VALLE 4 IS 25.000

INCREMENTAL VAME ANGLE VALUE FOR INITIAL VANE SETTING IS 2.00

DO YOU ACTEE? (Y/N)

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CONSTRAINT INFORMATION THERE ARE O CONSTRAINT SETS * * APPROXIMATE ANALYSIS/OPTIMIZATION INFORMATION ____ NUMBER OF FUNCTIONS APPROXIMATED, NF = NUMBER OF INFUT X-VECTORS, NPS = NUMBER OF INPUT X-F PAIRS, RPFS = X-VECTOR FROM ANALIZ, NPA = NOMINAL DESIGN, INCH = READ UNIT FOR X-VECTORS. ISCRX = READ UNIT FOR X-F PAIRS, ISCRXF = FRINT CONTROL, IPAPRX = MINIMUM APPROXIMATING CYCLES, KMIN = 5 MAXIMUM APPROXIMATING CYCLES, KMAX = 17 MAXIMUM DESIGNS USED IN FIT, NEMAX = 28 NOMINAL DESIGN PARAMETER, UNCM = 23 X-LCCATION INTUT PARAMETER, INXLOC = 0 F-LCCATION INPUT PARAMETER, INFLOC = 0 F-LOCATION INPUT PAPAMETER, INFLOC = TAYLER SERIES I.D. CODE, MAXTEM = TAYLER SERIES I.D. CODE, DELTA-X BOUNDS FOR APPROXIMATE OPTIMIZATION 0.2000E+01 0.2000E+01 0.2000E+01 0.2000E+01 MULTIPLIER ON DELX, XFACT1 = 0.1500E+01MULTIPLIER ON DELX, XFACT1 = 0.1500E+01 MULTIPLIER ON DELX, XFACT2 = 0.2000E+01 GLODAL LOCATIONS OF X-VARIABLES 1 2 3 4 GLOBAL LOCATIONS OF FUNCTIONS X-VECTORS INPUT FROM UNIT 5 ______ HUNDER 1 DESIGN NUMBER 2 DESIGN 0.20C0E+02 0.10C0E+02 0.500CE+01 0.5000E+01 NUMBER 3 DESIGN 0.2003E+02 0.1200E+02 0.5000E+01 0.5000E+01 NUMBER 4 DESIGN 0.2000E+02 0.1200E+02 0.7000E+01 0.5000E+01 NUMBER 5 DESIGN 5 0.2300E+02 0.1230E+02 0.7000E+01 0.7000E+01

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HOLD R	FMC CONSTA	NT AT	A VALUE	OF	5567.500	
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SET VANE 1 TO 20.00 DEGREES
SET VANE 2 TO 12.00 DEGREES
SET VANE 3 TO 7.00 DEGREES
SET VANE 4 TO 7.00 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.0200
APPROXIMATE OPTIMIZATION ITERATION HISTORY
APPROXIMATING FUNCTION 1 IS THE OBJECTIVE
DESIGN VARIABLE NUMBERS ASSOCIATED WITH AFFROXIMATING VARIABLES 1 2 3 4
BEGIN ITERATION NUMBER 1
NOMINAL DESIGN NUMBER = 5
X-VECTCR 0.20009E+02 0.12000E+02 0.70000E+01 0.70000E+01
FUNCTION VALUES 0.87020E+02
RESULTS OF AFPROXIMATE OPTIMIZATION
DELTA-X VECTOR
0.20000E+01 0.20000E+01 0.20000E+01 0.20000E+01
X-VECTCR 0.22000E+02 0.14000E+02 0.90000E+01 0.90000E+01
APPROXIMATE FUNCTION VALUES 0.8740CE+02 ************************************
SET VANE 1 TO 22.00 DEGREES
SET VANE 2 TO 10.00 DEGREES
SET VANE 3 TO 9.00 DEGREES
SET VAILE 4 TO 9.00 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CCHSTANT AT A VALUE OF 76.779
EFFICIENCY= 67.2000
PRECISE FUNCTION VALUES 0.87200E+02
BEGIN ITERATION NUMBER 2
NOMINAL DESIGN NUMBER = 6
X-VECTOR

0.22000E+02 0.14000E+02 0.9000E+01 0.9000E+01
FUNCTION VALUES
0.87200E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.17195E+01 0.20000E+01 0.20000E+01 0.20000E+01
X-VECTOR
0.2C281E+02 0.16C00E+02 0.11000E+02 0.11000E+02
AREPOVIMATE ENMATTON VALUES
APFROXIMATE FUNCTION VALUES 0.87580E+02
莱州斯萨斯士并由于西州大大河北部南部市州州州州州州州州
SET VANE 1 TO 20.28 DEGREES
SET VANE 2 TO 16.00 DEGREES
SET VANE 3 TO 11.00 DEGREES
SET VANE 4 TO 11.00 DEGREES
HOLD BONG CONSTANT AT A MALLE OF THE PAGE
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.0600
EFFICIENCY= 87.0600
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FRECISE FUNCTION VALUES
0.87350E+02
BEGIN ITERATION NUMBER 3
DEGIN INCINCTON NOW 3
NOMINAL DESIGN NUMBER = 7
X-VECTOR
0.20281E+02 0.16000E+02 0.11000E+02 0.11000E+02
FUNCTION VALUES
0.870605+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
0.30000E+01 -0.30000E+01 0.20000E+01 0.20000E+01
X-VECTOR
0.23281E+02 0.13000E+02 0.13000E+02 0.13000E+02
APPROXIMATE FUNCTION VALUES

0.87489E+02 SET VARE 1 TO 23.28 DEGREES SET VANE 2 TO 13.00 DEGREES SET VANE 3 TO 13.00 DEGREES SET VANE 4 TO 13.00 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 25.8100 ********* PRECISE FUNCTION VALUES 0.86810E+02 BEGIN ITERATION NUMBER NOMINAL DESIGN NUMBER = 8 X-VECTOR FUNCTION VALUES 0.35810E+02 RESULTS OF AFPROMIMATE OPTIMIZATION DELTA-X VECTOR 0.25161E+00 0.30000E+01 -0.30000E+01 0.20000E+01 X-VECTOR 0.23532E+02 0.16000E+02 0.10000E+02 0.15000E+02 AFFOOMINATE FUNCTION VALUES 0.37317E+02 SET VANE I TO 23.53 DEGREES SET VANE 2 TO 16.00 DECREES SET VANE 3 TO 10.00 DEGREES SET VANE 4 TO 15.00 DEGREES HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 86.5400

PRECISE FUNCTION VALUES 0.86540E+02
BEGIN ITERATION NUMBER 5
NCMINAL DESIGN NUMBER = 9
X-VECTCR 0.23532E+02_0.16000E+02_0.10000E+02_0.15000E+02_
FUNCTION VALUES 0.95540E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.20387E-01 0.58720E+00 0.23484E+01 -0.30000E+01
X-VECTCR 0.23552E+020.16587E+020.12348E+020.12000E+02_
APPROXIMATE FUNCTION VALUES 0.87039E+02 ************************************
SET VANE 1 TO 23.55 DEGREES
SET VALLE 2 TO 16.59 DECREES
SET VANE 3 TO 12.35 DECREES
SET VANE 4 TO 12.00 DECRESS
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 37.1300

FRECISE FUNCTION VALUES 0.871805+02
DEGIN ITERATION NUMBER 6
NOMINAL DESIGN NUMBER = 10 X-VECTOR
0.23552E+02 0.16587E+02 0.12348E+02 0.12000E+02
FUNCTION VALUES 0.07100E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.30000E+01 0.30000E+01 0.30000E+01 -0.30000E+01
X-VECTOR 0.26552E+02 0.19587E+02 0.15348E+02 0.90000E+01
AFF70XIHATE FUNCTION VALUES _0.87813E+02

SET VANE 1 TO 26.55 DEGREES	
SET VANE 2 TO 19.59 DEGREES	
SET VANE 3 TO 15.35 DEGREES	
SET VANE 4 TO 9.00 DEGREES	
HOLD RFMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3200	

PRECISE FUNCTION VALUES 0.07320E+02	····
BEGIN ITERATION NUMBER 7	
NOMINAL DESIGN NUMBER = 11	
X-VECTOR 0.26552E+02 0.19587E+02 0.15348E+02 0.90000	E+01
FUNCTION VALUES 0.87320E+02	
RESULTS OF APPROXIMATE OPTIMIZATION	
DELTA-X VECTOR	
-0.30000E+01 -0.37551E+00 -0.57363E+00 -0.22680	E+01
X-VECTOR 0.23552E+02 0.19212E+02 0.14775E+02 0.67320	E+01
APPROXIMATE FUNCTION VALUES	
0.874935+02 ********	
SET VAME 1 TO 23.55 DEGREES	
SET VAME 2 TO 19.21 DEGREES	
SET VAME 3 TO 14.77 DECREES	
SET VANS 4 TO 6.73 DEGREES	
HOLD FINC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.2700	
48484444444444444444444444444444444444	

BEGIN ITERATION NUMBER 8
NOMINAL DESIGN_NUMBER = 12
X-VECTOR 0.23552E+02 0.19212E+02 0.14775E+02 0.67320E+01
FUNCTION VALUES 0.87270E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.10000E+01 -0.10000E+01 -0.10000E+01 0.69491E+00
X-VECTCR 0.24552E+02 0.18212E+02 0.13775E+02 0.74269E+01
APPROXIMATE FUNCTION VALUES 0.87332E+02 ************************************
SET VANE 1 TO 24.55 DEGREES
SET VANE 2 TO 18.21 DEGREES
SET VAME 3 TO 13.77 DEGREES
SET VANE 4 TO 7.43 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.4700
PRECISE FUNCTION VALUES 0.87470E+02
BEGIN ITERATION NUMBER 9
MONTHAL DESIGN NUMBER = 13
X-VECTGR 0.24552E+02 0.18212E+02 0.13775E+02 0.74269E+01
FUNCTION VALUES 0.87470E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.30000E+01 -0.22538E+01 -0.27219E+01 -0.11338E+01
X-VECTOR 0.27552E+02 0.15958E+02 0.11053E+02 0.62931E+01
APPROXIMATE FUNCTION VALUES 0.87775E+02 ####################################
SET VANE 1 TO 27.55 DEGREES
SET VAILE 2 TO 15.95 DECREES

SET VANE 3 TO 11.05 DEGREES
SET VAME 4 TO 6.29 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.2300

PRECISE FUNCTION VALUES 0.87230E+02
BEGIN ITERATION NUMBER 10
NOMINAL DESIGN NUMBER = 14
X-VECTOR
0.27552E+02 0.15958E+02 0.11053E+02 0.62931E+01
FUNCTION VALUES 0.87230E+02
RESULTS OF APPROXIMATE OPTINIZATION
DELTA-X VECTOR -0.30000E+01 0.18264E+01 0.62902E+00 0.14670E+01
X-VECTCR
0.24552E+02 0.17734E+02 0.11632E+02 0.77601E+01
APPROXIMATE FUNCTION VALUES 0.87384E+02
董芸老夫弟 子在於在於漢字在先在民國的於於朝廷等與於陳廷斯斯 於與 與蘇
SET VANE 1 TO 24.55 DEGREES
SET VANE 2 TO 17.78 DEGREES
SET VANE 3 TO 11.68 DEGREES
SET VANE 4 TO 7.76 DEGREES
HOLD RENC CONSTANT AT A VALUE OF
HOLD DVS CONSTANT AT A VALUE GF 76.779 EFFICIENCY= 87.5200
张英雄女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女女
PRECISE FUNCTION VALUES
BEGIN TERATION NUMBER 11
NOMINAL DESIGN NUMBER = 15
X-VECTOR 0.24552E+02 0.17784E+02 0.11682E+02 0.77601E+01
FUNCTION VALUES 0.87520E+62

DELTA-X VECTOR -0.150948-00 0.30000E+01 -0.27914E+01 0.12013E+00 X-VECTOR 0.24402E+02 0.20784E+02 0.88905E+01 0.78802E+01 APPROXIMATE FUNCTION VALUES 0.87778E+02 ***********************************	RESULTS OF APPROXIMATE OPTIMIZATION
X-VECTOR 0.24402E+02 0.20784E+02 0.88905E+01 0.78802E+01 APPROXIMATE FUNCTION VALUES 0.87778E+02 ************************************	DELTA-X VECTOR
APPROXIMATE FUNCTION VALUES	-0.15094E+00 0.30000E+01 -0.27914E+01 0.12013E+00
######################################	X-VECTOR
0.87778E+02 ####################################	
SET VANE 1 TO 24.40 DEGREES SET VANE 2 TO 20.78 DEGREES SET VANE 3 TO 8.89 DEGREES SET VANE 4 TO 7.83 DEGREES HOLD RPIKE CONSTANT AT A VALUE OF 76.759 HOLD DVS CCHSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3000 *********************************	APPROXIMATE FUNCTION VALUES
SET VANE 1 TO 24.40 DEGREES SET VANE 2 TO 20.78 DEGREES SET VANE 3 TO 8.89 DEGREES SET VANE 4 TO 7.83 DEGREES HOLD RPIKE CONSTANT AT A VALUE OF 76.759 HOLD DVS CCHSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3000 *********************************	0.077705.00
SET VANE 2 TO 20.78 DEGREES SET VANE 3 TU 8.89 DEGREES SET VANE 4 TO 7.88 DEGREES HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CCISTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3000 *********************************	
SET VANE 3 TO	SET VANE 1 TO 24.40 DEGREES
SET VANE 4 TO	SET VANE 2 TO 20.78 DEGREES
HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CCHSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3000 *********************************	SET VANE 3 TO 8.89 DECREES
######################################	SET VANE 4 TO 7.89 DEGREES
######################################	
######################################	
DEGIN ITERATION NUMBER 12 NOMINAL DESIGN NUMBER = 16 X-VECTOR	******
DEGIN ITERATION NUMBER 12 NOMINAL DESIGN NUMBER = 16 X-VECTOR	
NOMINAL DESIGN NUMBER = 16 X-VECTOR	
X-VECTOR	BEGIN ITERATION NUMBER 12
0.24402E+02 0.20734E+02 0.88905E+01 0.78802E+01 FUNCTION VALUES 0.87300E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.12274E+00 -0.30000E+01 0.13476E+01 -0.12194E+00 X-VECTOR 0.24279E+02 0.17784E+02 0.10238E+02 0.77583E+01 APPROXIMATE FUNCTION VALUES 0.87408E+02 ************************************	NOMINAL DESIGN NUMBER = 16
0.87300E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.12274E+00 -0.30000E+01 0.13476E+01 -0.12194E+00 X-VECTOR 0.24279E+02 0.17784E+02 0.10238E+02 0.77583E+01 APPROXIMATE FUNCTION VALUES 0.87408E+02 ***********************************	
DELTA-X VECTOR -0.12274E+00 -0.30000E+01 0.13476E+01 -0.12194E+00 X-VECTOR 0.24279E+02 0.17784E+02 0.10238E+02 0.77583E+01 APPROXIMATE FUNCTION VALUES 0.87408E+02 ************************************	
-0.12274E+00 -0.30000E+01 0.13476E+01 -0.12194E+00 X-VECTCR	RESULTS OF APPROXIMATE OPTIMIZATION
-0.12274E+00 -0.30000E+01 0.13476E+01 -0.12194E+00 X-VECTCR	DELTA-X VECTOR
0.24279E+02 0.17784E+02 0.10238E+02 0.77583E+01 APPROXIMATE FUNCTION VALUES 0.87408E+02 ************************************	=
0.24279E+02 0.17784E+02 0.10238E+02 0.77583E+01 APPROXIMATE FUNCTION VALUES 0.87408E+02 ************************************	X-VECTOR
0.87408E+02 ************************************	
0.87408E+02 ************************************	APPROXIMATE FUNCTION VALUES
SET VANE 1 TO 24.28 DEGREES SET VANE 2 TO 17.78 DEGREES SET VANE 3 TO 10.24 DEGREES SET VANE 4 TO 7.76 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 NOLD DVS CONSTANT AT A VALUE OF 76.779	0.87408E+02
SET VANE 2 TO 17.78 DEGREES SET VANE 3 TO 10.24 DEGREES SET VANE 4 TO 7.76 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779	通报技术为解心的对抗性关系人类的现在分词人类人类的关系的关系的关系的关系的
SET VANE 2 TO 17.78 DEGREES SET VANE 3 TO 10.24 DEGREES SET VANE 4 TO 7.76 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 MOLD DVS CONSTANT AT A VALUE OF 76.779	
SET VANE 3 TO 10.24 DEGREES SET VANE 4 TO 7.76 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779	SET VANE 1 TO 24.28 DEGREES
SET VANE 4 TO 7.76 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779	SET VANE 2 TO 17.78 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779	SET VANE 3 TO 10.24 DEGREES
HOLD DVS CONSTANT AT A VALUE OF 76.779	SET VANE 4 TO 7.76 DEGREES
EFFICIERCY= 87.4900	HOLD DVS CONSTANT AT A VALUE OF 76.779
	EFFICIENCY= 87.4900

PRECISE FUNCTION VALUES 0.87490E+02 BEGIN ITERATION NUMBER 13 NOMINAL DESIGN NUMBER = 17 X-VECTOR FUNCTION VALUES 0.87490E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.13056E-01 -0.74511E+00 -0.18030E+01 -0.28726E+00 X-VECTOR 0.24266E+02 0.17039E+02 0.84351E+01 0.74710E+01 APPROXIMATE FUNCTION VALUES 0.87536E+02 SET VAME 1 TO 24.27 DEGREES SET VARE 2 TO 17.04 DEGREES SET VANE 3 TO 8.44 DEGREES SET VANE 4 TO 7.47 DEGREES HOLD PENG CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.4900 PRECISE FUNCTION VALUES 0.87493E+02 BEGIN ITERATION NUMBER 14 NOMINAL DESIGN NUMBER = 18 X-VEC , OR 0.24266E+02 0.17039E+02 0.84351E+01 0.74710E+01 FUNCTION VALUES __0.87490E+02 RESULTS OF AFPROMIMATE OPTIMIZATION DELTA-X VECTOR 0.13986E+00 0.15656E-01 -0.10000E+01 0.26333E+00 X-VECTOR 0.244C6E+02 0.17055E+02 0.74351E+01 0.77344E+01 APPROMIMATE FUNCTION VALUES 0.87502E+02

SET VANE 1 TO 24.41 DEGREES
SET VANE 2 TO 17.05 DEGREES
SET VANE 3 TO 7.44 DEGREES
SET VANE 4 TO 7.73 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.4300
新黎州黄州大水市大学大学大学及开发等于公司大学及关系的英语是
PPECISE FUNCTION VALUES 0.87430E+02
FINAL RESULT OF APPROXIMATE OPTIMIZATION
NOMINAL DESIGN NUMBER = 15
X-VECTOR 0.24552E+02 0.17784E+02 0.11652E+02 0.77601E+01
FUNCTION VALUES
RESULTS OF APPROXIMATE ANALYSIS/CPTIMIZATICM

GLOBAL LOCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X)
APPROXIMATION IS DASED ON 19 DESIGNS
NOMINAL DESIGN IS DESIGN NUMBER 15
VALUES OF X-VARIABLES 0.24555+02 0.17785+02 0.11686+02 0.77606+01
VALUES OF FUNCTIONS, F(X) 0.875CE+02
COEFFICIENTS OF TAYLOR SERIES EXPANSION
PARAMETER 1 = GLOBAL VARIABLE 7
LIMEAR TERMS, DEL F -0.1274E-01 -0.1145E-01 -0.3592E-02 -0.2156E-01

74

NOW-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT

RCW I -0.2531E-01 -0.14012-01 RCH -0.9645E-02 ROW 4 -0.3166E-01 OPTIMIZATION RESULTS OBJECTIVE FUNCTION

FUNCTION VALUE 0.87520E+02 DESIGN VARIABLES LOHER GLODAL UPPER VAR. NO. ĸЭ. BOUND ID VALUE BOUND 1 _ __1 ____0.10000E+02 __0.24552E+02 __0.35000E+02 0.50000E+01 0.17784E+02 0.25900E+02 0.50000E+01 0.11682E+02 0.25000E+02 2 3 3 3 0.50000E+01 0.77301E+01 0.25000E+02 ****** FINAL SOLUTION VALUES ****** VANE ANGLE FOR VANE 1 IS 24.55 DEGREES VANS ANGLE FOR VANE 2 IS 17.78 DECREES VAME ANGLE FOR VAME 3 IS 11.68 DEGREES EFFICIENCY= 87.5200 RPMC HAS HELD CONSTANT AT 5567.50
DVS WAS HELD CONSTANT AT 76.78 PROGRAM CALLS TO ANALIZ ICALC CALLS __ 1 19 1

STATOR VANE OPTIMIZER

PROTOTYPE-SOFTWARE CAPABLE OF GUIDING THE OPTIMIZATION OF ---

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

BY: PRATT & WHITNEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION

PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU

_		_		_						_		RAINTS	_
	NO	1	GOAL	I	RPMC	r:C	54	DVS	0.L.	I	5.M.	I EFF	I
	_1	I.	EFF	I	. X			X		I	-	I	I
	2	I	EFF	I	X	-	-	-	X	I	-	I -	1
	3	I	EFF	I	-	×	X	-	-	I	-	I -	1
	4	I	EFF	1	X	-	-	×	-	I	MIN	I -	3
	5	I.	EFF _	_ <u>T</u>	X	-			X	I	MIN _	I	.]
	6	I	EFF	I	-	X	X	-	-	I	MIN	I -	1
	7	I	s.m.	I	X	-	-	×	-	I	-	I -	1
	8	I	S.M.	I	X	-	-	-	X	I	-	I -	1
	9.	I.	_ S.M	. I	-	X	X _		-	I	- -	I	
	10	I	s.m.	I	X	~	-	×	-	I	-	I MIN	3
	11	I	S.M.	I	X	-	-	-	Х	I	-	I MIN	1
	12	I	S.M.	I	-	X	X	-	-	I	-	I MIN	1
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	15	İ	HIN HC	I	X	-	-	-	X	I		I MIN	I
	16	I	FR	Ī	X	X	-	-	-	I	MIN	I HIN	I
	17	I.	FR	I	Χ	-		-	. . X	I	MIN	I MIN .	·I
	YOU	J }	HAVE SEI	LΕ	CTED	TO OF	HIT	IZE SU	RGE MA	٩RI	SIN HO	LDING	

CORRECTED SPEED (RPMC) AND DISCHARGE VALVE SETTING (DVS) CONSTANT

the state of the s	
WITH NO CONSTRAINT ON EFFICIENCY	
HOLD REMC CONSTANT AT 5567.500	
HOLD DVS CONSTANT AT 76.779	
OPTIMIZING 4 VANE ANGLE(S)	
LOWER BOUND FOR VANE 1 IS 10.0	100
DO YOU AGREE? (Y/N)	
LOHER BOUND FOR VAME 2 IS 5.0	000
DO YOU AGREE? (Y/N)	
LOWER BOUND FOR VANE 3 IS 5.0	000
DO YOU ACREE? (Y/N)	
LOHER ECUND FOR VANE 4 IS 5.0	200
DO YOU AGREE? (Y/N)	,
UPPER BOUND FOR VANE 1 IS 35.0	000
DO YOU AGREE? (Y/N)	
UPPER DOUND FOR VANE 2 IS 25.0	000
DO_YOU_AGREE? (Y/N)	
UPPER SCURD FOR VANE 3 IS 25.0	000
DO YOU AGREE? (Y/N)	

UPFER BOUND FOR VANE 4 IS 25.000

DO YOU AGREE? (Y/N)

INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTING IS -2.00

PROCEDING PAGE BLANK-NOW FILMER

CONTROL	L PARAME	TERS;					
	ATION CO				ALC =		
			N VARIABI				
NUILLER	OF SENS	TITATII	VARIABLE: VARIABLE:), 55 NO	NSV =	0	
NUMBER	OF FUNC	TI CHUII	Y IND-SPAC	.e, 82	VAR =	0	
NUTIOER	UF AFFI. Engormat	TON BOIL	KS VAR. NT CODE,	TON	PRX =	4	
	FRINT CO		41 COSE,		201 - <u> </u>	<u>1</u>	
00000	rkini co	ue,		10	J66 -	٠	
			SALC				
VALUE	HEANIN	S					
1	SINGLE	ANALYS:	rs .				
2	OPTIMI	ZATION					
3	_ SENSIT	IVITY					
				SPACE			
5	UPTIMU	TI SENSI	117711 117711	261			
	APPRUX		FUNCTION S FIVITY FIMIZATIO	JN			
*_ * .OP	TIMIZATI	ON INFOR	NOITAM			· 	
			R OF OBJECTION				
CCRMIN	PAPAREL	FK2 (TL	ZERO, CO	WITH DE	PAULI W	ILL CAR	R-MIDE)
IPRINT	ITMAX	ICNDIA	NSCAL	ITRI	LINO	DJ NAC	MX1 NFC
							MX1 NFD
5	20	5	0	3	0	10)0
5 FDCH	20	5	0	3	0	10)0 . Thin
FDCH 0.1000	20	FDCH: 0.100	1 1 100E-02	CT -0.50	0 000E-01	10 C1 0.	MIN 140000E-02
FDCH 0.1000	20 00E-01	FDCH: 0.100	1 1 100E-02	CT -0.50	0 000E-01	10 C1 0.	MIN 40000E-02
FDCH 0.1000	20	FDCHN 0.100	1 000E-02	CT -0.50	000E-01	10 C1 0.	MIN 40000E-02
5 FDCH 0.1000	20	FDCHN 0.100	1 1 100E-02	CT -0.50	000E-01	10 C1 0.	MIN 40000E-02
FDCH 0.1000 CTL -0.1000	20 20E-01	FDCHN 0.100 CTLM1 0.100	0 1 000E-02 000E-02	CT -0.50 THET. 0.10	000E-01 A 300E+01	C1 0. F)	11IN 40000E-02
FDCH 0.1000 CTL -0.1000	2020	FDCHN 0.100 CTLMN 0.100	0 1 000E-02 N 000E-02	CT -0.50 THET 0.10	0 000E-01 A 000E+01	C1 0. F)	MIN 40000E-02 11 0
FDCH 0.1000 CTL -0.1000	20 20E-01	FDCHN 0.100 CTLMN 0.100	0 1 000E-02 N 000E-02	CT -0.50 THET 0.10	0 000E-01 A 000E+01	C1 0. F)	11IN 40000E-02
FDCH 0.1000 CTL -0.1000 DELFUY 0.1000	2020	FDCHN 0.100 CTLMN 0.100 DADEN 0.0	0 1 1000E-02 IN 000E-02	CT -0.50 THET 0.10	0 000E-01 A 000E+01	C1 0. F)	MIN 40000E-02 11 0
FDCH 0.1000 CTL -0.1000 DELFUY 0.1000 DESIGN NCH-2ES	20	FDCHN 0.100 CTLHN 0.100 DADER 0.0 E INFORMAL VALUE	0 1 000E-02 IN 000E-02 IN 14TION E WILL OVE	THET. 0.10 ALFH. 0.10	000E-01 A 000E+01 AX 000E+00	F) 0.	MIN 40000E-02 11 0
FDCH 0.1000 CTL -0.1000 DELFUY 0.1000 DESIGN NON-ZEF D. V.	20	FDCHN 0.100 CTLHN 0.100 DADER 0.0 E INFORMAL VALUE	0 1 000E-02 IN 000E-02 IN 14TION E WILL OVE	THET. 0.10 ALFH. 0.10	000E-01 A 000E+01 AX 000E+00	F) 0.	MIN 40000E-02 II 0 0 003J1
FOCH 0.1000 CTL -0.1000 OELFUM 0.1000 DESIGN NON-ZET D. V.	20	FDCHN 0.100 CTLMN 0.100 DADFR 0.0 E INFORMAL VALUE	O 1 1000E-02 IN 1000E-02 IN 1ATION HILL OVE	CT -0.50 THET. 0.10 ALFH 0.10	0 000E-01 A 000E+01 AX 000E+00 MODULE INITI	CT O. FF O. AE	MIN 40000E-02 II 0 003J1
FOCH 0.1000 CTL -0.1000 OESIGN NOH-ZEF D. V. NO. 1	20	FDCHN 0.100 CTLMN 0.100 DADFN 0.0 E INFORNAL VALUE R D 0.0 CE+02	0 1 000E-02 IN 000E-02 UN 14TION HILL OVE UPPER BOUND 0.35000	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE	000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2703	CT O. FF O. AE O. INPUT	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5 FDCH 0.1000 CTL -0.1000 DELFUY 0.1000 DESIGN NON-ZEF D. V. NO. 1 2	20	FDCHN 0.100 CTLM1 0.100 DADFN 0.0 E INFORNAL VALUE R D CE+02 0E+01	0 1 000E-02 IN 000E-02 IN 14TION HILL OVE UPPER BOUND 0.350000	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE	000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2703	CT 0. FF 0. AE 0. INPUT. AL E 00+02 00+02	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5 FDCH 0.1000 CTL -0.1000 DELFUM 0.1000 DESIGN NCH-ZES D. V. NO. 1 2 3	20	FDCHN 0.100 CTLMN 0.100 DADFN 0.0 E INFORN AL VALUE R D DCE+02 0E+01 0E+01	1000E-02 IN DODE-02 IN HATION HALL OVI UPPER EQUID 0.350001 0.250001	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE	0 000E-01 A 000E+01 AX _ 000E+00 MCDULE INITI VALU 0.200 0.1600	TNPUT AL E OE+02 OE+02 OE+02	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DELFUY 0.1000 DESIGN NCH-ZEF D. V. NO. 1 2	20	FDCHN 0.100 CTLM1 0.100 DADFN 0.0 E INFORNAL VALUE R D CE+02 0E+01	1 1000E-02 IN 1000E-02 IN 14TION E HILL OVI UPPER EQUID 0.350001 0.250001	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE	0 000E-01 A 000E+01 AX _ 000E+00 MCDULE INITI VALU 0.200 0.1600	TNPUT AL E OE+02 OE+02 OE+02	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
5 FDCH 0.1000 CTL -0.1000 DESIGN NON-ZET D. V. NO. 1 2	20	FDCHN 0.100 CTLMN 0.100 DADEN 0.0 E INFORN AL VALUE D 05+02 05+01 06+01 06+01	1000E-02 IN DODE-02 IN HATION HALL OVI UPPER EQUID 0.350001 0.250001	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE	0 000E-01 A 000E+01 AX _ 000E+00 MCDULE INITI VALU 0.200 0.1600	CT 0. FF 0. AE 0. INPUT AL E 0E+02 0E+02	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DELFUM 0.1000 DESIGN NOH-ZEF D. V. NO. 1 2 3 4	20	FDCHN 0.100 CTLMN 0.100 DADFN 0.0 E INFORN AL VALUE R 0 CE+02 0E+01 0E+01 CE+01 ES GLCBAN	001 000E-02 IN 000E-02 IN MILL OVE UPFOR BOUND 0.35000E 0.25000E	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE E+02 E+02 E+02 E+02 E+02	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2703 0.1600 0.1300 0.9000	CT 0. FF 0. AE 0. INPUT AL E 0E+02 0E+02	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DELFUM 0.1000 DESIGN NOH-ZEM 1 2 3 4	20	FDCHN 0.100 CTLMN 0.100 DADFR 0.0 E INFORN AL VALUE R 0 CE+02 OE+01 OE+01 OE+01 CE+01 VAR. NO	001 1000E-02 IN 000E-02 IN 1ATION I WILL OVE UPFOR EQUIND 0.350000 0.250000 0.250000	THET. 0.10 ALFH 0.10 ER-RIDE +02 +02 +02 +02 IPLYING	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2709 0.1600 0.1300	INPUT AL E OE+02 OE+02 OE+01	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DELFUM 0.1000 DESIGN NOH-ZEM 1 2 3 4	20	FDCHN 0.100 CTLMN 0.100 DADFR 0.0 E INFORN AL VALUE R 0 CE+02 OE+01 OE+01 OE+01 CE+01 VAR. NO	001 000E-02 IN 000E-02 IN MILL OVE UPFOR BOUND 0.35000E 0.25000E	THET. 0.10 ALFH 0.10 ER-RIDE +02 +02 +02 +02 IPLYING	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2709 0.1600 0.1300	INPUT AL E OE+02 OE+02 OE+01	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5	20	FDCHN 0.100 CTLMN 0.100 DADFR 0.0 E INFORN AL VALUE R 0 CE+02 OE+01 OE+01 OE+01 CE+01 VAR. NO	1 1000E-02 1M 1000E-02 1M 14TION 14TION 14TION 14TION 14TION 14TION 10.350001 0.250001 0.250001	THET. 0.10 ALFH 0.10 ER-RIDE +02 +02 +02 +02 IPLYING	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2709 0.1600 0.1300	INPUT AL E OE+02 OE+02 OE+01	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DELFUM 0.1000 DESIGN NOH-ZEM 1 2 3 4	20 00E-01 00E-01 VARIABL 00E-02 VARIABL 0.1006 0.5000 0.5000 VARIABL 0.V.	FDCHM 0.100 CTLMM 0.100 DADEN 0.0 E INFORM AL VALUE R D CE+02 0E+01 0E+01 CE+01 CE+01	0	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE E+02 E+02 E+02 E+02 CTOR CTOR CTOR CTOR CTOR CTOR CTOR CTOR	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2709 0.1600 0.1300	INPUT AL E OE+02 OE+02 OE+01	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DESIGN NCH-2EF DD V. NO. 1 2 3 4	20 00E-01 00E-01 VARIABL 70 INITI LOWE 20UN 0.1000 0.5000 0.5000 VARIABL VARIABL VARIABL VARIABL	FDCHM 0.100 CTLMM 0.100 DADEN 0.0 E INFORM AL VALUE B CE+02 0E+01 0E+01 0E+01 VAR. NO	0	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE E+02 E+02 E+02 E+02 CTOR CTOR CTOR CTOR CTOR CTOR CTOR CTOR	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2709 0.1600 0.1300	INPUT AL E OE+02 OE+02 OE+01	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0
5 FDCH 0.1000 CTL -0.1000 DESIGN NCH-ZER D. V. NO. 1 2 3 4 DESIGN ID 1	20 00E-01 00E-02 VARIABL 00 INITI LONE EQUIX 0.1006 0.5000 0.5000 VARIABL VARIABL VARIABL VARIABL VARIABL	FDCHN 0.100 CTLM1 0.100 DADFN 0.0 EINFORN AL VALUE COE+02 OE+02 OE+01 OE+01 OE+01 OE+01 OE+01 OE+01 OE+01 OE+01	0	CT -0.50 THET 0.10 ALFH 0.10 ER-RIDE E+02 E+02 E+02 E+02 CTOR CTOR CTOR CTOR CTOR CTOR CTOR CTOR	0 000E-01 A 000E+01 AX 000E+00 MCDULE INITI VALU 0.2709 0.1600 0.1300	INPUT AL E OE+02 OE+02 OE+01	MIN 40000E-02 II 0 003J1 10000E+00 SCALE 0.0 0.0

* *_APPROXIMATE ANALYSIS/OPTIMIZATION.INFORMATION
NUMBER OF FUNCTIONS APPROXIMATED, NF = 0
NUMBER OF INFUT X-VECTORS, NES = 5
NUMBER OF INPUT X-F PAIRS,NPFS =O
X-VECTOR FROM ANALIZ: NPA = 0
X-VECTOR FROM ANALIZ, NPA = 0 NOMINAL DESIGN, INOM = 0 READ UNIT FOR X-VECTORS, ISCRX = 5 READ UNIT FOR X-F PAIRS, ISCRXF = 5
READ UNIT FOR X-VECTORS, ISCRX = 5
READ UNIT FOR X-F. PAIRS, ISCRXF = 5
PRINT CONTROL, IPAPRX = 1
MINIMUM APPROXIMATING CYCLES, KMIN = 5
MAXIMUM APPROXIMATING CYCLES, KMAX =17
MAXIMUM DESIGNS USED IN FIT, NPMAX = 28
NOMINAL DESIGN PARAMETER, JNCM = 28 X-LOCATION INFUT PARAMETER, INXLOC = 0
X-LOCATION INFUT PARAMETER, INXLOC = 0
E-LCCATION INFUT PARAMETER,INFLOC =O
TAYLER SERIES I.D. CCDE, MAXTRM = 2
DELTA-X BOUNDS FOR APPROXIMATE OPTIMIZATION
0.2000E+01 0.2000E+01 0.2000E+01 0.2000E+01
WARREST OF BUILDING WARRANT OF A SERVICE
MULTIPLIER ON DELX, XFACT1 = 0.1500E+01 MULTIPLIER_ON DELX, XFACT2 = 0.2000E+01
MOLITPLIER_ON_DELX;XFACT2 =0.2000E+01
GLOBAL LOCATIONS OF X-VARIABLES
1234
GLOBAL LOCATIONS OF FUNCTIONS
6
X-VECTOPS INPUT FROM UNIT 5
AND TO BE OF STANK
NUMBER 1 DESIGN 1
0.2900E+02 0.18CCE+02 0.1500E+02 0.1100E+02
The second secon
NUMBER 2 DESIGN 2
0.2700E+02 0.1800E+02 0.1500E+02 0.1100E+02
The state of the s
NUMBER 3 DESIGN 3
0.2700E+02
0.27002402 0.10002402 0.15002402 0.11002402
- Mark and the second of the s
NUMBER 4 DESIGN 4
0.270GE+02 0.160GE+02 0.130CE+02 0.110GE+02
The second secon
MUMPER & RECTAL E
NUMBER 5 DESIGN 5 0.2700E+02 0.1600E+02 0.1300E+02 0.9000E+01
* * ESTIMATED DATA STORAGE REQUIREMENTS
The same of the sa
REAL INTEGER
THRUT EVECUTION AVAILABLE THRUT EVECUTION AVAILABLE
33

SETVANE_1_TO29.00_DEGREES	
SET VANE 2 TO 18.00 DEGREES	
SET_VANE_3_TO15.00_DEGREES	
SET VARE 4 TO 11.00 DEGREES	
HOLD RENC CONSTANT AT A VALUE OF HOLD DVS CONSTANT AT A VALUE OF SURGE MARGIN= 8.2600	_5567.500 76.779

SET VANE 1 TO 27.00 DEGREES	
SET_VANE_2_TO18.00_DEGREES	
SET VANE 3 TO 15.00 DEGREES	
SET_VANE_4_TO11.00_DEGREES	
HOLD RPMC CONSTANT AT A VALUE OF HOLD DVS CONSTANT AT A VALUE OF SURGE_MARGIN=	556 7.5 00 76.779

SET_VANE_1_TO27,00 DEGREES	
SET VANE 2 TO 16.00 DEGREES	
SET_VANE_3_TO15.00_DEGREES	
SET VANE 4 TO 11.00 DEGREES	
HOLD RING CONSTANT AT A VALUE OF HOLD DV3 CONSTANT AT A VALUE OF SURGE MARGIN= 8.8700	5567.500 76.779

SET VANE 1 TO 27.00 DEGREES	
SET, VAPIE 2 TO 16.00 DEGREES	
SET VANE 3 TO 13.00 DEGREES	
SET_VANE 4_TO11.00_DEGREES	
HOLD REMC CONSTANT AT A VALUE OF HOLD DVS CONSTANT AT A VALUE OF SUPGE MARGIN= 9.1200	5567.500 76.779

_SET_VANE_1_TO27.00_DEGREES
SET VANE 2 TO 16.00 DEGREES
SET_VANE 3_TO13.00_DEGREES
SET VANE 4 TO 9.00 DEGREES
HOLD RPMC CONSTANT AT_A VALUE OF5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.1800
APPROXIMATE OPTIMIZATION ITERATION HISTORY
APPROXIMATING FUNCTION 1 IS THE OBJECTIVE
DESIGN VARIABLE NUMBERS ASSOCIATED WITH APPROXIMATING VARIABLES 1 2 3 4
BEGIN ITERATION NUMBER 1
NOMINAL DESIGN NUMBER = 5
X-VECTOR 0.27000E+020.16000E+020.13000E+020.90000E+01
FUNCTION VALUES 0.91800E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
X-VECTOR 0.25000E+02
APPROXIMATE FUNCTION VALUES 0.10100E+02 EXHANALANZANANANANANANANANANANANANANANANANA
SET VANE 1 TO 25.00 DEGREES
SET VAME 2 TO 14.00 DEGREES
SET VANE 3 TO 11.00 DECREES
SET VARE 4 TO 7.00 DEGREES
HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.6300

FRECISE FUNCTION VALUES0.96300E+01
DECTY TERRATION AND A
BEGIN ITERATION NUMBER 2
NOMINAL DESIGN NUMBER = 6
_X-VECTOR

			0.70000E+01
FUNCTION VALUE 0.96300E+01			
ESULTS OF APP	ROXIMATE OPTI	MIZATION	
ELTA-X VECTOR			
	-0.20000E+01	-0.20000E+01	-0.20000E+01
K-VECTOR			
0.25915E+02	0.12000E+02	0.90000E+01	0.50000E+01
APPROXIMATE FL		;	
********		****	
			•
SET.VANE 1.TO.	25.91 DEGRE	ES	
SET VANE 2 TO	12.00 DEGRE	ES	
SET_VANE.3_TO	9.00 DEGRE	ES	
SET VANE 4 TO	5.00 DECRE	ES	
HOLD REMC CONS	TANT AT A VAL	UE OF 55	67.500
HOLD DVS CONS	TANT AT A VAL	UE OF	76.779

SURGE MARGIN= ***************** PRECISE FUNCTI 0.96500E+01	********		
**************************************	ON AVEGES		
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATIO	ON VALUES		
PRECISE FUNCTI	ON VALUES ON NUMBER 3	7	
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATION NOMINAL DESIGN X-VECTOR	ON VALUES ON NUMBER 3	7	
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATION NOMINAL DESIGN X-VECTOR	ON VALUES ON NUMBER 3	7	
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATION NOMINAL DESIGN X-VECTOR 0.25915E+02	ON VALUES ON NUMBER 3 I NUMBER =	7	0.50000E+01
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATION NOMINAL DESIGN X-VECTOR 0.25915E+02	ON VALUES ON NUMBER 3 I NUMBER =	7 0.90000E+01	0.50000E+01
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATIO NOMINAL DESICN X-VECTOR 0.25915E+02 FUNCTION VALUE 0.96500E+01	ON VALUES	7 0.90000E+01	0.50000E+01
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATION NOMINAL DESIGN X-VECTOR 0.25915E+02 FUNCTION VALUE	ON VALUES ON NUMBER = 0.12000E+02	7 0.90000E+01	0.50000E+01
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATION NOMINAL DESIGN X-VECTOR 0.25915E+02 FUNCTION VALUE 0.96500E+01 RESULTS OF APP	ON VALUES ON NUMBER 3 I NUMBER = 0.12000E+02 S PROXIMATE OPTI 0.30000E+01	7 0.90000E+01 MIZATION	0.50000E+01
PRECISE FUNCTI 0.96500E+01 BEGIN ITERATIO NOMINAL DESICN X-VECTOR 0.25915E+02 FUNCTION VALUE 0.96500E+01 RESULTS OF APP DELTA-X VECTOR -0.12697E+01 X-VECTOR	ON VALUES ON NUMBER 3 I NUMBER = 0.12000E+02 S PROXIMATE OPTI 0.30000E+01	7 0.90000E+01 MIZATION	0.50000E+01 -0.19073E-05

	0.10246E+02 ************************************
	SET VANE 1 TO 24.65 DEGREES
	SET VANE 2 TO 15.00 DEGREES
	SET VANE 3 TO 7.00 DEGREES
	SET VANE 4 TO 5.00 DEGREES
	HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SUBGE MARGINE 9.8100
	SURGE MARGIN= 9.8100

	PRECISE FUNCTION VALUES 0.98100E+01
	BEGIN ITERATION NUMBER 4
	NOMINAL DESIGN NUMBER = 8.
	X-VECTOR
	0.24645E+02 0.15000E+02 0.70000E+01 0.50000E+01
	FUNCTION VALUES 0.93100E+01
	RESULTS OF APPROXIMATE OPTIMIZATION
	DELTA-X VECTOR
	0.53915E-03 -0.38695E+000.54003E+000.10737E-06
	X-VECTOR 0.24644E+02 0.14613E+02 0.75400E+01 0.50000E+01
	APPROXIMATE FUNCTION VALUES
	0.93143E+01

-	SET VANE 1 TO 24.64 DEGREES
_	SET_VAME 2 TO14.61 DEGREES
	SET VARE 3 TO 7.54 DEGREES
	SET_VANE 4_TO5.00 DEGREES
-	HOLD RPMC CONSTANT AT A VALUE OF 5567.500
	HOLD DVS CONSTANT AT A VALUE OF 76.779
	SURGE MARGIN= 9.7300

PRECISE FUNCTION VALUES 0.97300E+01

NOMINAL DESIG	SN RUMBER = 9
X-VECTOR	
	2_ 0.14613E+020.75400E+01_0.50000E+01
FUNCTION VALUE	IEE
0.97300E+01	
RESULTS OF A	PPROXIMATE OPTIMIZATION
DELTA V VECT	20
	PR
X-VECTOR 0.24545E+02	20.116135+020.5000CE+010.80000E+01
O.11230E+02	FUNCTION VALUES
SET VANE 1 TO	24.65 DEGREES
SET VANE 2 TO	11.61 DEGREES
	<u>-</u>
SET VANE 3 TO	5.00 DEGREES
SET VANE 4 TO	8.00 DEGREES
אחום פפויר כמו	ISTANT AT A VALUE OF 5567.500
	ISTANT, AT A VALUE OF 5557.500
SURGE MARGIN	
******	· · · · · · · · · · · · · · · · · · ·
PRECISE FUNCT	
0.98600E+01	
BEGIN ITERATI	ON NUMBER 6
NOMINAL DESIG	N NUMBER = 10
X-VECTOR	
	A 11/175:00 A PARAMETAL A ARRANGE
0.24645E+02	0.11613E+02 0.50000E+01 0.80000E+01
FUNCTION VALUE	
0.92600E+01	The state of the s
RESULTS OF AF	PROXIMATE OPTIMIZATION
DELTA-X VECTO	
0.1783CE+00	0.16957E+01 0.0 -0.21006E+00
X-VECTOR	The state of the s
X-VECTOR	0.13309E+C2 0.50000E+01 0.77899E+01
0.24824E+02	

需要用用的实验 从是有性的现在分词使用的现在分词使用的现在分词
_SET_VANE_1_TO24.82 DEGREES
SET VANE 2 TO 13.31 DEGREES
SET_VANE_3_TO5.00_DEGREES
SET VANE 4 TO 7.79 DEGREES
HOLD REMC CONSTANT AT A VALUE OF5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.7100

_PRECISE FUNCTION_VALUES
BEGIN ITERATION NUMBER 7
NOMINAL DESIGN NUMBER = 11
X-VECTC?
0.24324E+02 0.13309E+02 0.50000E+01 0.77899E+01
FUNCTION_VALUES
0.971C0E+01
PESULTS OF APPROXIMATE CPTIMIZATION
DELTA-X VECTOR
-0.25304E+01 -0.30000E+01 0.30000E+01 0.17803E+01
X-VECTCR 0.22243E+02 0.10309E+02 0.80000E+01 0.95708E+01
_APPROXIMATE_FUNCTION_VALUES
0.10101E+02 ####################################
SET VANE 1 TO 22.24 DEGREES
SET VANE 2 TO 10.31 DEGREES
SET VARE 3 TO 8.00 DEGREES
SET VANE 4 TO 9.57 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 NOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.9000

PRECISE FUNCTION VALUES 0.99000E+01

BEGIN ITERATION NUMBER 8
NOMINAL DESIGN NUMBER ==12
X-VECTOR 0.22243E+02 0.10309E+02 0.80000E+01 0.95708E+01
FUNCTION VALUES 0.99000E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR0.11631E+010.30000E+010.59621E+000.80193E+00
X-VECTOR 0.23407E+02 0.73088E+01 0.74038E+01 0.87689E+01
APPRGXIMATE FUNCTION VALUES 0.99335E+01 ************************************
SET VANE 1 TO 23.41 DECREES
SET_VANE 2 .TO7.31_DEGREES
SET VANE 3 TO 7.40 DEGREES
SET_VANE_4_TO8.77_DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.8500
PRECISE FUNCTION VALUES 0.90500E+01
BEGIN ITERATION NUMBER 9
NOMINAL DESIGN NUMBER = 13
X-VECTOR 0.23407E+02 0.73088E+01 0.74030E+01 0.87689E+01
FUNCTION VALUES 0.93509E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELT1-X VECTOR
X-VECTOR 0.23113E+020.10309E+020.73294E+010.89847E+01
APPROXIMATE FUNCTION VALUES 0.99191E+01
SET VANE 1 TO 23.11 DEGREES
SET VANE 2 TO 10.31 DIGREES
SET VANE 3 TO 7.33 DECREES
SET VARE 4 TO 8.98 DEGREES

HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779
SURGE MARGIN= 9.9000
######################################
PRECISE FUNCTION VALUES _0.99000E+01
0.440005+01
BEGIN_ITERATION_NUMBER10
NOMINAL DESIGN NUMBER = 14
X-VECTOR
0.23113E+02 0.10309E+02 0.73294E+01 0.89847E+01
FUNCTION VALUES0.99000E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA- < VECTOR 0.99433E-01 0.64460E+00 -0.39840E-01 -0.61202E+00
X-VECTO?
0.23212E+02 0.10953E+02 0.72896E+01 0.83727E+01
APPROXIMATE FUNCTION VALUES0.99032E+01
经验证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证
SET_VAME_1_TO23.21 DEGREES
SET VANE 2 TO 10.95 DEGREES
SET_VANE_3_TO7.29_DEGREES
SET VANS 4 TO 8.37 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500
SURGE MARGIN= 9.6500

PRECISE FUNCTION_VALUES
0.90500E+01
BEGIN ITERATION NUMBER 11
NOMINAL DESIGN NUMBER = 15
X-VECTCR 0.23212E+02 0.10953E+02 0.72896E+01 0.83727E+01
FUNCTION VALUES

	RESULTS OF APPROXIMATE OPTIMIZATION
	DELTA-X VECTOR 0.47319E+00 -0.14892E+01 -0.22697E+00 0.30000E+01
_	X-VECTOR
	0.23685E+02 0.94642E+01 0.70626E+01 0.11373E+02
	APPROXIMATE FUNCTION VALUES
**	0.99059E+01 ************************************
;	SET VANE 1 TO 23.69 DEGREES
	SET VANE 2 TO 9.46 DEGREES
	SET VANE 3 TO 7.06 DEGREES
	SET VAME 4 TO 11.37 DEGREES
	HOLD RENC CONSTANT AT A VALUE OF 5567.500
	HOLD DVS CONSTANT AT A VALUE OF 76.779 Surse margin= 9.6600
**	******
	FRECISE FUNCTION VALUES 0.96800E+01
1	BEGIN ITERATION NUMBER 12
	NOMINAL DESIGN MUMBER =16
:	X-VECTOR 0.23635E+02 0.94642E+01 0.70626E+01 0.11373E+02
	FUNCTION VALUES 0.96800E+01
-	RESULTS OF APPROXIMATE OPTIMIZATION
	DELTA-X VECTOR 0.11755E+010.10896E+010.26895E+000.30000E+01
	X-VECTOR 0.22510E+02 0.10554E+02 0.73316E+01 0.83727E+01
	APPROMIMATE FUNCTION VALUES 0.99175E+01
**	**************************************
;	SET VAME 1 TO 22.51 DEGREES
	SET_VAME_2_TO10.55_DECREES
:	SET VANE 3 TO 7.33 DEGREES
	SET_VANS_4_TO8.37_DEGREES
1	HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURCE_MARGIN= 9.9500

PRECISE FUNCTION VALUES 0.99500E+01

BEGI TTERATION NUMBER 13
NOMINAL DESIGN NUMBER = 17
X-VECTOR
0.22510E+02 _ 0.10554E+02_ 0.73316E+01_ 0.83727E+01_
FUNCTION VALUES
0.99500E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.64875E+00 0.49088E+00 -0.10047E+00 -0.17918E+01
X-VECTOR 0.21851E+020.11045E+020.72311E+010.65809E+01
APPROXIMATE FUNCTION VALUES
0.99370E+01
美考 美美林的名式公司 在中心分别的 医克克特氏 皮肤炎 医克克特氏炎 医克克特氏炎 医克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克特氏管疗 医克克特氏管炎 医克克特氏管疗 医克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克特氏病 医克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克特氏管炎 医克克氏管炎 医克克克特氏管炎 医克克特氏管疗 医克克克氏管炎 医克克氏管炎 医克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克克氏管炎 医克克氏管疗 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医克克氏管炎 医疗性原生原生原生原生原生原生原生原生原生原生原生原生原生原生原生原生原生原生原生
SET VANE 1 TO 21.86 DECREES
SET VANE 2 TO 11.04 DEGREES
SET VANE 3 TO 7.23 DEGREES
SET VARE 4 TO 6.58 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779
SURGE MARGIN= 10.0700

FRECISE FUNCTION VALUES0.10070E+02
DEGIN_ITERATION_NUMBER14
NOMINAL DESIGN NUMBER = 18
X-VECTOR
0.21861E+02 0.11045E+02 0.72311E+01 0.65809E+01
FUNCTION VALUES
0.10070E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.16422E+01 -0.20345E+00 -0.76764E+00 -0.15809E+01
X-VECTC9
0.20219E+02 0.10841E+02 0.64633E+01 0.500G0E+01
APPROXIMATE FUNCTION VALUES
0.10127E+02

SET_VANE 1 TO20.22 DEGREES
SET VANE 2 TO 10.84 DEGREES
SET_VANE_3_TO6.46_DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 10.2200

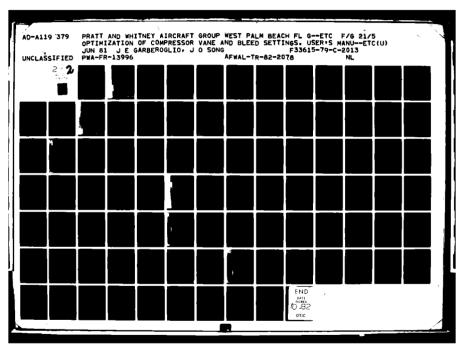
PRECISE FUNCTION VALUES
0.10220E+02
BEGIN ITERATION NUMBER 15
NOMINAL DESIGN NUMBER = 19
X-VECTCR 0.20219E+02 0.10841E+02 0.64633E+01 0.50000E+01
0.202192402 0.100412402 0.040332401 0.300032401
FUNCTION VALUES
0.10220E+02
PESULTS OF AFFROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.14843E+01 -0.19052E+00 -0.14633E+01 0.0
X-VECTCR
0.10734E+02 0.10651E+02 0.50000E+01 0.50000E+01
APPROXIMATE_FUNCTION_VALUES
0.100/05:00
0.10249E+02 ************************************
SET VANE 1 TO 18.73 DEGREES
SET VANE 2 TO 10.65 DECREES
SET VANE 3 TO 5.00 DEGREES
SET VAME 4 TO 5.00 DEGREES
NOID COME CONCTANT AT A VALUE OF THE PAGE
HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD CVS CONSTANT AT A VALUE OF 76.779
SURCE MURGINE 10.2500

FRECISE FUNCTION VALUES 0.10250E+02

BEGIN ITERATION NUMBER 16
NOMINAL DESIGN NUMBER = 20
X-VECTOR 0.13734E+02 0.10651E+02 0.50000E+01 0.50000E+01
FUNCTION VALUES 0.10250E+02
RESULTS OF AFPROXIMATE OPTIMIZATION
DELTA-X VECTOR0.30376E+00 0.76676E-01 0.00.13762E-06
X-VECTCR 0.16431E+02 0.10727E+02 0.50000E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.10251E+02 ####################################
SET VANE 1 TO 18.43 DEGREES
SET_VANE 2_TO10.73 DESCREES
SET VANE 3 TO 5.00 DEGREES
SET_VANE 4 TO 5.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 10.2200
PRECISE FUNCTION VALUES 0.10020E+00
BEGIN ITERATION NUMBER 17
NOMINAL DESIGN NUMBER = 21
X-VECTOR 0.184315+02 0.10727E+02 0.50000E+01_0.50000E+01_
FUNCTION VALUES 0.10020E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X.VECTOR. 0.50583E+00 -0.12569E-01 0.31959E-02 0.0
X-VECTCR 0.18937E+020.10715E+020.50032E+010.50000E+01
APPROXIMATE FUNCTION VALUES 0.10223E+02 ####################################
SET VANC 1 TO 18.94 DEGREES
SET VANS 0 TO 19.71 DECREES
SET VAME 3 TO 5.00 DEGREES
SET VANE 4 TO 5.00 DECREES

HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 10.3000

PRECISE FUNCTION VALUES
FINAL RESULT OF APPROXIMATE OPTIMIZATION
NOMINAL DESIGN NUMBER = 22
X-VECTOR 0.18937E+02 0.10715E+02 0.50032E+01 0.50000E+01
FUNCTION VALUES
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION
TITLE
GLOBAL LCCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X)
APPROXIMATION IS BASED ON 22 DESIGNS
NOMINAL DESIGN IS DESIGN NUMBER 22
VALUES OF X-VARIABLES 0.1894E+02 0.1071E+02 0.5003E+01 0.5000E+01
VALUES OF FUNCTIONS, F(X) 0.1030E+02
COEFFICIENTS OF TAYLOR SERIES EXPANSION
PARAMETER 1 = GLOBAL VARIABLE 6
LINEAR TERMS, DEL F 0.1099E-010.2025E-020.1383E-010.2630E-01
NON-LINEAR TERMS, H. DEGINING WITH DIAGONAL ELEMENT
RCH 1 -0.1935E-01
-0.1110E-01
RCH 3 -0.1810E-02
RG!! 4 -0.6010E-00



OPTIMIZATION RESULTS

DESIGN_VARIABLES					
					Uboro
ID	NO.	ATORYT	LOWER BOUND	VALUE	UPPER BOUND
	1	1	0.10000E+02_		
2	9	•	D 50000E+01	0 1071EF±09	0 250005+04
3	3	3	0.50000E+01 0.50000E+01	0.50032E+01	0.25000E+02
	4 		0.5000CE+01	0.50000E+01	0.25000E+02
******	# FINAL	. SOLUTION V	ALUES *****		
VANE ANS	LE FOR V	ANE 1 IS	18.94 DE	GREES	
YAHEAHG	SLE_FOR.V	ANE 2.15	10.71 DE	GREES	
VANE AND	LE FOR V	ANE 3 IS	5.00 DE	GREES	
VANE_ANG	LE FOR N	/ANE 4 . IS	5.00 DE	GREES	
SURGE MA	RGIN=	10.3000			
RPMC W45	HELD CO	NSTANT AT	5567.50		
		NSTANT AT	76.78		
PROGRAM	CALLS TO	ANALIZ			
ICALO	CALLS	,			

STATOR VANE OPTIMIZER

PROTOTYPE SOFTWARE CAPABLE OF GUIDING THE OPTIMIZATION OF ...

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

BY: FRATT & WHITNEY AIRCRAFT GROUP GOVERNMENT FRODUCTS DIVISION

PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU

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	3	I	SFF	I	-	X	X	-	-	I	-	I	-	I
	4	I	EFF	I	X	-	-	X	-	I	MIN	I	-	I
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	7	I	S.H.	I	X	-	-	X	-	I	-	I	-	I
	8	I	S.M.	I	×	-	-	-	X	I	-	I	-	I
	9	I	S.M	I	-	X_	_X_			I		1	-	I
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	11	I	S.M.	I	X	-	-	-	X	I	-	1	MIN	I
	12	I	S.M.	I	-	X	X	-	-	I	-	I	MIN	I
	13	I	SM/BLD	I	X	X		-	-	I	-	1	-	1
	14	I	DH XAH	I	_ X	-	-		X	I	MIN	I	HIN	I
	15	I	KIN NC	I	X	-	-	-	X	I	MIN	I	MIN	I
	16	I	2.5	I	X	X	-	-	-	I	MIN	I	MIN	I
	17	I	FR	I	X	-	-	-	X	I	MIN	I	MIN .	I
	YOU	J	HAVE SE	LE	CTED T	O CF	TIH	ZE EF	FICIE	YC'	Y HOLD	I	KG	

CORRECTED SPEED (RFMC) AND DISCHARGE VALVE SETTING (DVS) CONSTANT

HILLE CONSTRAINING SURGE MARGIN TO A MINIMUM VALUE HOLD REAC COMSTANT AT 5567.500 HOLD EVS CONSTANT AT 76.779 OPTIMIZING 4 VANE ANGLE(S) LOUER DOUND FOR VANE 1 IS 10.000 DO YOU AGREE? (Y/N) LCHER BOUND FOR VANE 2 IS 5.000 DO YOU AGREE? (Y/H) LOWER BOUND FOR VANE 3 IS 5.000 DO YOU AGREE? (Y/N) LCHER BOUND FOR VANE 4 IS 5.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 1 IS 35.000 DO YOU AGREE? (Y/H) UPPER BOUND FOR VANE 2 IS 25.000 DO YOU AGREE? (Y/N)

UPPER BOUND FOR VANE 3 IS 25.000
DO YOU AGREE? (Y/N)
UFFER BOUND FOR V/NE 4 IS 25.000
DO YOU AGREE? (Y/N)
LOHER BOUND VALUE FOR SM IS 10.000
UPPER BOUND VALUE FOR SM IS 1000.000
INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTING IS -2.00

Annual State

* * APPROXIMATE ANALYSIS/OPTIMIZATION INFORMATION
NUMBER OF FUNCTIONS APPROXIMATED, NF = 0
MUNDER OF INPUT X-VECTORS, NPS = 5
NUMBER OF INPUT X-F PAIRS, NPFS = 0
X-VECTOR FROM ANALIZ, NPA = 0 NOMINAL DESIGN, INOM = 0 READ UNIT FOR X-VECTORS, ISCRX = 5 READ UNIT FOR X-F PAIRS, ISCRXF = 5 FRINT CONTROL, IPAPRX = 1
NOMINAL DESIGN, INOM = 0
READ UNIT FOR X-VECTORS, ISCRX = 5
READ UNIT FOR X-F PAIRS, ISCRXF = 5
EDINI CONTROL TRAPPY = 1
There downloady at Alina 2
MINIMUM APPROXIMATING CYCLES, KMIN = 5 HAXIMUM APPROXIMATING CYCLES, KMAX = 17
HAXIBUH AFFROXIMATING CYCLES, KMAX = 17
MAXIMUM DESIGNS USED IN FIT, NPMAX = 28
NOMINAL DESIGN PARAMETER, JNCM ≈ 28
X-LCCATION INPUT PARAMETER. INXLCC = 0
F-ICCATION INCUT DADAMATED. THE DC = 0
MAXIMUM DESIGNS USED IN FIT, NPMAX = 28 NOMINAL DESIGN PARAMETER, UNCM = 28 X-LOCATION INPUT PARAMETER, INXLOC = 0 F-LOCATION INPUT PARAMETER, INFLOC = 0 TAYLER SERIES I.D. CODE, MAXTRM = 2
MATER SERIES I.U. CCUE; MAXIRII - 2
DELTA-X BOUNDS FOR APPROXIMATE OPTIMIZATION
0.2000E+01 0.2000E+01 0.2000E+01 0.2000E+01
MULTIPLIER ON DELX, XFACT1 = 0.1500E+01 MULTIPLIER ON DELX, XFACT2 = 0.2000E+01
MOLITPLIER ON DELX, XFACTI - 0.1500E+01
MULTIPLIER ON DELX, XFACT2 = 0.2000E+01
GLOBAL LOCATIONS OF X-VARIABLES
1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS
7 6
X-VECTORS INFUT FROM UNIT 5
The state of the s
Number 1 design 1
NUMBER 1 DESIGN 1 0.2900E+02 0.1800E+02 0.1500E+02 0.1100E+02
0.2900E+02 0.1890E+02 0.1500E+02 0.1100E+02
0.2900E+02 0.1800E+02 0.1500E+02 0.1100E+02
0.2900E+02 0.1890E+02 0.1500E+02 0.1100E+02
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0.2900E+02 0.1800E+02 0.1500E+02 0.1100E+02 NUMBER 2 DESIGN 2 0.2700E+02 0.1800E+02 0.1500E+02 0.1100E+02 NUMBER 3 DESIGN 3 0.2700E+02 0.1600E+02 0.1500E+02 0.1100E+02 NUMBER 4 DESIGN 4 0.2700E+02 0.1600E+02 0.1300E+02 0.1100E+02 NUMBER 5 DESIGN 5
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0.2900E+02 0.1800E+02 0.1500E+02 0.1100E+02 NUMBER 2 DESIGN 2 0.2700E+02 0.1800E+02 0.1500E+02 0.1100E+02 NUMBER 3 DESIGN 3 0.2760E+02 0.1600E+02 0.1500E+02 0.1100E+02 NUMBER 4 DESIGN 4 0.2700E+02 0.1600E+02 0.1300E+02 0.1100E+02 NUMBER 5 DESIGN 5 0.2700E+02 0.1600E+02 0.1300E+02 0.9000E+01 ** ESTIMATED DATA STCRASE REQUIREMENTS REAL INTEGER INPUT EXECUTION AVAILABLE INPUT EXECUTION AVAILABLE 37 335 5000 26 71 1000
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HOLD DVS CONSTANT AT A VALUE OF EFFICIENCY= 87.1400 SURGE MARGIN= 8.2600 **********************************	7.500 5.779
HOLD DVS CONSTANT AT A VALUE OF EFFICIENCY= 87.1400 SURGE MARGIN= 8.2600 **********************************	

SET VANE 1 TO 27.00 DEGREES SET VANE 2 TO 18.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD CAN CONSTANT AT A VALUE OF 76 DEGREES SURGE MARGIN= 8.7500 SURGE MARGIN= 8.7500 **********************************	
SET VANE 1 TO 27.00 DEGREES SET VANE 2 TO 18.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD RENC CONSTANT AT A VALUE OF 76 DEGREES HOLD DVS CONSTANT AT A VALUE OF 76 DEGREES SURGE MARGIN= 8.7500 **********************************	
SET VAME 2 TO 18.00 DEGREES SET VAME 3 TO 15.00 DEGREES SET VAME 4 TO 11.00 DEGREES HOLD FRAC CONSTANT AT A VALUE OF 76 DEGREES SURGE MARGIN= 8.7500 SURGE MARGIN= 8.7500 **********************************	
SET VAME 3 TO 15.00 DEGREES SET VAME 4 TO 11.00 DEGREES HOLD REMC CONSTANT AT A VALUE OF 76 HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.3200 SURGE MARGIN= 8.75C0 ***********************************	
SET VANE 4 TO 11.00 DEGREES HOLD RENC CONSTANT AT A VALUE OF TO EFFICIENCY= 87.3200 SURGE MARGIN= 8.7500 **********************************	
HOLD REMC CONSTANT AT A VALUE OF HOLD CVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.3200 SURGE MARGIN= 8.75C0 ***********************************	
HOLD DVS CONSTANT AT A VALUE OF EFFICIENCY= 87.3200 SURGE MARGIN= 8.7500 **********************************	
SET VANE 1 TO 27.00 DEGREES SET VANE 2 TO 16.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD REMC COMSTANT AT A VALUE OF 556 HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	7.500 5.779
SET VANE 1 TO 27.00 DEGREES SET VANE 2 TO 16.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD REMC CONSTANT AT A VALUE OF 556 HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	
SET VANE 2 TO 16.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD REMC CONSTANT AT A VALUE OF 556 HOLD DV3 CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	
SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD RENC CONSTANT AT A VALUE OF 76 HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	• •
SET VANE 4 TO 11.00 DEGREES HOLD RENC CONSTANT AT A VALUE OF 556 HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	
HOLD REMC CONSTANT AT A VALUE OF 556 HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	2001.5
HOLD DVS CONSTANT AT A VALUE OF 76 EFFICIENCY= 87.2400	
SURGE MARGIN= 8.8700	7.500 5.779
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SET VANS 1 TO 27.00 DEGREES	
SET VANE 2 TO 16.00 DEGREES	
SET VANE 3 TO 13.00 DEGREES	
SET VANS 4 TO 11.00 DEGREES	
EFFICIENCY= 87.2800	
SURGE MARGIN= 9.1200	7.500 5.779

SET VANE						
SET VANE						
SET VANE						
HOLD RPHC HOLD DVS EFFICIENCY	CONSTANT	AT A V			779	
"SURGE" MAR	GIN= 9	.1800 —			,	
APPROXIMA	TE OPTIMI	ZATION	ITERATIO	HISTORY		
APPROXIMA	TING FUNC	TION	1 IS THE	E OBJECTIV	/E	
APFROXIMA' 2	TING FUNC	TIONS A	SSCCIATE	WITH CO!	NSTRAINTS	
	RIABLE KU 2 3		SSOCIATE	HITH API	PROXIMATING	ÄVÄ
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NOMINAL D	ESIGN NUK	BER = .	, 5 .,			
X-VECTOR 0.27000	E+02 0.1)0E+02 0	.90800E+01	
FUNCTION 1 0.87330	VALUES E+02 0.9	1800E+0			and the man	
RESULTS O	F ÄPFROXI	MATE OP	TIMIZATIO	ON		
DELTA-X V		03435+0	0 -0.200	00E+010	.20000E+01_	
				00E+02 0	.70000E+01	
AFFROXINA 0.87598 *********	E+02 0.9	9782E+0	1			
SET VANE	1 TO 25	.00 DEG	REES			
SET_VANE	2_T015	.70 DEG	REES			
SET VARE	3 TO 11	.00 DEG	REES			
SET_VANE	4_T07	.00_DEG	REES			
HOLD RPNC	CONSTANT	V A TA	ALUE OF	5567. 76.	500	
••						
SURGE HAR	GIN= 9	.6100				

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BEGIN ITERATION NUMBER 2
NOMINAL DESIGN NUMBER = 6
X-VECTOR
0.25000E+02 0.15697E+02 0.11000E+02 0.70000E+01
FUNCTION VALUES
0.87510E+02 0.96100E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.46831E+00 -0.20000E+01 -0.20000E+01 -0.17435E+01
X-VECTOR
0.24531E+02 0.13697E+02 0.90000E+01 0.52565E+01
APPROXIMATE FUNCTION VALUES
0.87526E+02
相解解的关系并对: 我有好我的我就有有有有的的故意就是我就就就就就
SET VANE 1 TO 24.53 DEGREES
SET VANE 2 TO 13.70 DEGREES
SET VANE 3 TO 9.00 DECREES
SET VANE 4 TO 5.26 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIESCY= 87.3400
SURGE HARGIN= 9.8000
模技架积效长大利地汇接按规划投 机等效光线光线模式或影光线模型
PRECISE FUNCTION VALUES 0.87340E+02 0.98000E+01
BEGIN ITERATION NUMBER 3
NOMINAL DESIGN NUMBER = 7
X-VECTCR 0.24531E+02 0.13697E+02 0.90000E+01 0.52565E+01
FUNCTION VALUES 0.87340E+02 0.98000E+01

RESULTS OF APPROXIMATE OPTIMIZATION

DELTA-X VECTOR -0.97002E+00 0.30000E+01 -0.20000E+01 -0.25652E+00
X-VECTO?
0.23551E+02 0.16697E+02 0.70000E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES
0.87758E+02 0.99999E+01
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SET_VANE_1_TO 23.56 DEGREES
SET VANE 2 TO 16.70 DEGREES
SET VANE 3 TO 7.00 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500
HOLD RATIC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIERCY= 87.3500
SURGE MARGIN= 9.8300
按照按据外规则的对外交易的证据实验的证据的证据的证据的证据的证据的证据
PRECISE FUNCTION VALUES
0.87350E+02 0.93300E+01
BEGIN ITERATION NUMBER 4
NOMINAL DESIGN NUMBER = 8
X-VECTOR 0.23561E+00 0.16697E+02 0.70000E+01 0.50000E+01
FUECTICH VALUES
0.87330E+02 0.98300E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.11059E+01 -0.11585E+01 -0.41264E+00 0.18275E-06
X-VECTOR
C.24667E+02 0.15539E+02 0.65874E+01 0.50000E+01
. FROXIHATE FUNCTION VALUES
`.87108E+02
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SET VANE 1 TO 24.67 DEGREES

SET VANE 2 TO 15.54 DEGREES
SET VANE 3 TO 6.59 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIENCY= 87.2900
SURGE MARGIN= 9.8300
排光光光光光光光光光光光线的电影性感染的现在分词形式电影影響
FRECISE FUNCTION VALUES 0.87290E+02 0.98300E+01
BEGIN ITERATION NUMBER 5
NOMINAL DESIGN NUMBER = 9
X-VECTOR 0.24567E+02 0.1553SE+02 0.65374E+01 0.50000E+01
FUNCTION VALUES 0.87290E+02 0.98300E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.93281E+00 0.40022E-01 0.70299E+00 0.37014E+00
X-VECTOR
0.23734E+02 0.15570E+02 0.72904E+01 0.53701E+01
APPROXIMATE FUNCTION VALUES
0.87102E+02
我我亲亲亲亲,也不知识我亲心不知,心气为对为对为我们也不知识的
SET VANE 1 TO 23.73 DEGREES
SET VANE 2 TO 15.58 DEGREES
SET VANE 3 TO 7.29 DEGREES
SET VANE 4 TO 5.37 DEGREES
HOLD RAME CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIENCY= 87.3900
SURGE MARGIN= 10.0000
特殊技术技术共和关的政策的政策的关系关系关系的政策的关系

PRECISE FUNCTION VALUES 0.87390E+02 0.1000CE+02 BEGIN ITERATION NUMBER 6 NOMINAL DESIGN NUMBER = 10 X-VECTOR 0.23734E+02 0.15578E+02 0.72904E+01 0.53701E+01 FUNCTION VALUES 0.87390E+02 0.10000E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.30000E+01 0.30000E+01 0.18914E+01 0.30000E+01 X-VECTOR 0.20734E+02 0.18578E+02 0.91818E+01 0.83701E+01 AFPROXIMATE FUNCTION VALUES 0.87347E+02 0.10666E+62 新游戏技术并并对行业的关系的关系的特别的对抗对抗的对抗的对抗的 SET VANE 1 TO 20.73 DEGREES SET VANE 2 TO 18.58 DEGREES SET VAME 3 TO 9.18 DEGREES SET VANE 4 TO 8.37 DEGREES HOLD REMC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFI LLCCY= 87.2200 SURGE MARGIN= 9.7200 ******* PRECISE FUNCTION VALUES 0.87220E+02 0.97200E+01 BEGIN ITERATION NUMBER 7 NOMINAL DESIGN NUMBER = 11 X-VECTOR 0.20734E+02 0.18578E+02 0.91818E+01 0.83701E+01 FUNCTION VALUES 0.87220E+02 0.97200E+01 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR 0.13537E+01 -0.30000E+01 -0.45008E+00 -0.17061E+01 X-VECTOR 0.22033E+02 0.15578E+02 0.87317E+01 0.66640E+01

APPROXIMATE FUNCTION VALUES
0.87309E+02 0.99692E+01
SET_VANE 1 TO 22.09 DEGREES
SET VANC I TO 22.09 DEGREES
SET VANE 2 TO 15.58 DEGREES
SET_VANE_3_TO 8.73 DEGREES
SET VANE 4 TO 6.66 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIENCY= 87.4000
SURGE MARGIN= 9.8100
弹架外架架架外架架架架架架架架架架架架架架架架架架架架架架
PRECISE FUNCTION VALUES
0.87400E+02 0.98103E+01
BEGIN ITERATION NUMBER 8
NOMINAL DESIGN NUMBER = 12
X-VECTCR
0.22088E+02 0.15570E+02 0.87317E+01 0.66640E+01
FUNCTION VALUES
0.87400E+02 0.98100E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR . 0.94308E+00 0.56411E+00 -0.31326E+00 0.64617E+00
. 0.743002400 0.304112400 40.313262400 0.6461/2400
X-VECTCR
0.23031E+02 0.16142E+02 0.84184E+01 0.73102E+01
APPROXIMATE FUNCTION VALUES
0.87343E+02 0.99064E+01
被领领的关系,然后就是这个人,然后就是这个人,然后就是这个人,不是这个人,就是这个人,
SET VANE 1 TO 23.03 DEGREES
SET VANE 2 TO 16.14 DEGREES
SET VANE 3 TO 8.42 DEGREES
SET VANE 4 TO 7.31 DEGREES
HOLD RESIC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779
HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.4500
SURGE MARGIN= 9.9100
美国家政治政治的"汉河南美国的城市政治政治政治政治政治政治政治政治政治
PRECISE FUNCTION VALUES

BEGIN ITERATION NUMBER 9
NOMINAL DESIGN NUMBER = 13
X-VECTOR 0.23031E+02 0.16142E+02 0.84184E+01 0.73102E+01
FUNCTION VALUES 0.87450E+02 0.99100E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.66503E+00 -0.73410E+00 -0.10000E+01 0.93294E+00
X-VECTOR 0.23696E+02 0.15403E+02 0.74184E+01 0.82431E+01
APPROMINATE FUNCTION VALUES 0.87436E+02 0.10003E+02 ************************************
SET VANE 1 TO 23.70 DEGREES
SET VANE 2 TO 15.41 DEGREES
SET VANE 3 TO 7.42 DEGREES
SET VANE 4 TO 8.24 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3900
SURGE MARGIN= 9.9000
· · · · · · · · · · · · · · · · · · ·
PRECISE FUNCTION VALUES 1.37390E+02 0.99000E+01
FINAL RESULT OF APPROXIMATE OPTIMIZATION
NOMINAL DESIGN NUMBER = 10
X-VECTOR 0.23734E+02 0.15578E+02 0.72904E+01 0.53701E+01
FUNCTION VALUES 0.87390E+02 0.10000E+02
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION
TITLE
GLOBAL LOCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X)

APPROXIMA	TION IS BASED ON	14 DESIGNS	
NOMINAL D	ESIGN IS DESIGN NUM	BER 10	
VALUES OF 0.2373	X-VARIABLES E+02 0.1558E+02	0.7290E+01	0.5370E+01
	FUNCTIONS, F(X) E+02 0.1000E+02		emana new Caratary Viananah R. p. pr. and Spar .
COEFFICIE	NTS OF TAYLOR SERIE	S EXPANSION	
PARAMETER	1 = GLOSAL VARI	ABLE 7	
	RMS, DEL F E-010.2707E-01	_0.3280E_01	0.2149E-01
NON-LINEAR	TERMS, H, BEGININ	G WITH DIAGO	IAL ELEMENT
ROH 1 -0.25421			
RON 2 24318	E-01		
ROH 3 0.43921	E-02		
RCH 4 -0.1624			
PARAMETER	2 = GLCDAL VARI	ABLE 6	
LINEAR_TER 	RMS, DEL F E-01 -0.9764E-02	-0.2890E-01	-0.2387E-C1
NON-LINEAR	TERMS, H, BEGININ	G WITH DIAGON	NAL ELEMENT
ROW 1 -0.41946	E-01		
ROH 2 -0.31878		· · · · · · · · · · · · · · · · · · ·	The art services . It is also in distribution of relation
-0.1436E	:-01	The second section sections	de Anno Cambrio Cambrio Anno II divido Anno de Antigo de
RCW 4 0.54558	:-02		

OPTIMIZATION RESULTS

ID 1 2 3 4 DESIGN CO ID 1 *********************************	NO. 1 2 3 4 INSTRAIN GLGSAL VAR. N 6	VAR. NO. 1 2 3 4 ITS LOWE RO. EGU 0.10000 . SOLUTION V	0.50000E+01 0.50000E+01 0.50000E+01	UPPE UE BOU E+02 0.10000	0.25000E+00 0.25000E+00 0.25000E+00
2 3 4 DESIGN CO ID I WANNE ANGL VANE ANGL VANE ANGL	2 3 4 NSTRAIN GLGSAL VAR. N 6 FINAL	Z 3 4 ITS LOWE 0.10000 0.10000	0.50000E+01 0.50000E+01 0.50000E+01 RR ND VAI E+02 0.10000	0.15578E+02 0.72904E+01 0.53701E+01 UPPE UE BOU E+02 0.10000	0.25000E+00 0.25000E+00 0.25000E+00
2 3 4 DESIGN CO ID I WANNE ANGL VANE ANGL VANE ANGL	2 3 4 NSTRAIN GLGSAL VAR. N 6 FINAL	Z 3 4 ITS LOWE 0.10000 0.10000	0.50000E+01 0.50000E+01 0.50000E+01 RR ND VAI E+02 0.10000	0.15578E+02 0.72904E+01 0.53701E+01 UPPE UE BOU E+02 0.10000	0.25000E+0; 0.25000E+0; 0.25000E+0;
DESIGN CO IO I WANNE ANGL VANE ANGL VANE ANGL	GLGSAL VAR. N 6	LOWERO. EGU 0.10000 SOLUTION V	0.50000E+01 C.50000E+01 RR ND VAL E+02 0.10000	0.72904E+01 0.53701E+01 	0.25000E+0: 0.25000E+0:
DESIGN CO ID I ************* VANE ANGL VANE ANGL VANE ANGL	GLGSAL VAR. N 6 FINAL	TS LOWE O. LOWE O. LOWE O. LOWE O. LOWE VANE 1 IS	C.500CCE+01 R ND VAI E+02 0.1000	0.53701E+01 UPPE UE BOU E+02 0.10000	0.25000E+0
IO 1 ********** VANE ANGL VANE ANGL VANE ANGL	GLGSAL VAR. N 6 FINAL	LOWE RO. EGU 0.10000 . SOLUTION V	R ND VAI E+02 0.10000	UPPE UE BOU E+02 0.10000	IND
IO 1 ********** VANE ANGL VANE ANGL VANE ANGL	FINAL	O.10000 SOLUTION V	ND VALUES *******	UE BOL E+02 0.10000	IND
IO 1 ********** VANE ANGL VANE ANGL VANE ANGL	FINAL	O.10000 SOLUTION V	ND VALUES *******	UE BOL E+02 0.10000	
VANE ANGL	FINAL	SOLUTION V	/ALUES ******		
VANE ANGL VANE ANGL VANE ANGL	E FOR V	ANE 1 IS	/ALUES ******		
YANE ANGL		ANE 2 IS	15.58 DE	GRZES	
		ANE 3 IS			
FEFTCTENC	E FCR V	ANE 4 IS	5.37 09	GREES	
		87.3900			
PRIC HAS	HELD CC	NSTANT AT	5567.50 76.78		
OVS WAS	HELD CC	HSTANT AT	76.78		
PROGRAM C	ALLS TO	ANALIZ			
	CYLLS				
1	1 14				
3	1				

STATOR VANE OPTIMIZER

PROTOTYPE SOFTWARE CAPABLE OF GUIDING THE OPTIMIZATION OF ...

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

EY: PRATT & WHITNEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION

PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU

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CORRECTED SPEED (RPMC) AND DISCHARGE VALVE SETTING (DVS) CONSTANT

```
MHILE CONSTRAINING SURGE MARGIN TO A MINIMUM VALUE
HOLD REMC CONSTANT AT 5567.500
HOLD EVS CONSTANT AT
                          76.779
OPTIMIZING 4 VANE ANGLE(S)__
 LOWER SCUND FOR VANE 1 IS
                             10.000
DO YCU AGREE? (Y/N)
 LOMER BOUND FOR VANE 2 IS
                              5.000
DO_YOU AGREE? (Y/N)_
 LONER BOUND FOR VANE 3 IS
                              5.000
 DO YOU AGREE? (Y/N)
 LCHER BOUND FOR VANE 4 IS
                              5.000
DO YOU AGREE? (Y/N)
                             35.000
UPPER BOUND FOR VANE 1 IS
DO YOU AGREE? (Y/N)
UPPER BOUND FOR VANE 2 IS
_DO_YOU_AGREE?_(Y/N)_
```

UPPER BOUND FOR VANE 3 IS 25.000 DO YOU AGREE? (Y/N) UPPER SCUID FOR VANE 4 IS 25.000 _DO YOU.AGREE? (Y/H)........ LCHER SCUND VALUE FOR SH IS 10.000 UPPER COUND VALUE FOR SH IS 1000.000 INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTING IS -2.00

109

				*****		*****		## ##	
CONTSO	L PARAM	FTFRS:							
		ONTROL.		NCAL	C =	6			
			EN VARIAB	LES,_ NO	V =				
			VARIABLE	-	Y =	-			
				CE, NEVA					
				NXAPR LPNPU					
	FRINT C				G =				
CSICIII	ATTON C	MITONI. I	SCALC.						
	MEANI								
1	SINGL	E ANALYS	IS .						
2	OPTIM	IZATION	is						
4 5	OPTTM	TRIABLE I JM SENSIT	UNCTION	SPACE					
			TIMIZATI	ОИ					
									
<u>*_</u> *_02	TIMIZAT	ION INFO	MATION				·		
				CTIVE			,		
MULTIP	LIER (N	EGATIVE 1	NDICATES	MINIMIZA	TION) =	0.1	000E+01		
				MIN DEFA					
IFRIHT S	ITMAX	ICNDIR 5	NSCAL	ITRM	LINOBJ	SAN 1	MX1 NFD	G	
0.100	20E-01	0.100	C0E-02	-0.5000	0E-01	0.	MIN 40000E-02		
CTL		CTLMI		THETA		PH			
-0.100	00E-01	0.100	00E-02	0.1000	0E+01	0.	0		
				ALPHAX					
0.100	00E-02	0.0		0.1000	0E+00	0.	10000E+00		
DESIGN	VARIAB	LE INFORM	IATION						
NON-ZE	PO_INIT	TAL. VALUE	WILL OV	ER-RIDE.M	ODULE I	NPUT			
D. V.	LON	iR 'D	UPPER		INITIAL	i			
nJ. 1	0.100	10 10E+02	0.35000	E+02 0	27000E	+02	SCALE		
ž	0.500	GE+01	_0.25000	E+02 0	.16000E	+02	0.0		
3	0.500	10+30	0.25000	E+02 0	.13000E	+02	0.0		
4	0.500	10E+01	0.25006	E+02 0	.90000E	+01	0.0		
DESIGN	VARIABI	.ES							
	D. V.	GLOBAL	MULT	IPLYING					
ID 1	NO.		. FA	CTCR 000E+01					
3	2 3 4	3	0.100	000E+01					
4	4	4		000E+01				alla alla angles an	n der Effension der Steiner und der Steine d
COKSTR!	AINT INF	ORMATION							
THERE !	MRE 1 C	ONSTRAIN	T SETS						
:	ilobal //o 1	GLUBAL VAD 0	LINEAR	LCXER	M	ORMALI	IZATION	UPPER BOUND 0.10000E+04	NORMALIZAT
	******	YAR. C	70	DUUNU		FAU	I UK	BUUND	FACTOR

* * APPROXIMATE ANALYSIS/UPT.	MIZATION INFORMATION	
NUMBER OF FUNCTIONS APPROXIMA	TER. NE - A	
NUMBER OF INPUT X-F PAIRS,	NPFS = 0	
X-VECTOR FROM ANALIZ, NOMINAL DESIGN.	NPA = 0 Inom = 0	
READ UNIT FOR X-VECTORS,	INUT = U	
REAU. UNIT. FUR. X-VECTORS,	13CRX =5	
READ UNIT FOR X-F PAIRS,	ISCRXF = 5	
FRINT CONTROL,	IPAPRX = 1	
MINIMUM APPROXIMATING CYCLES		
MAXIMUM APPROXIMATING CYCLES		
MAXIMUM DESIGNS USED IN FIT,		
NOMINAL DESIGN PARAMETER,	JNCM = 28	
X-LCCATION INFUT PARAMETER		
F-LOCATION INPUT PARAMETER,		
TAYLER SERIES I.D. CODE,	MAXTRM = 2	
DELTA-X BOUNDS FOR APPROXIMAT		
0.2000E+01 0.2000E+01 0.200	0E+01 0.2000E+01	
MULTIPLIER ON DELX		
MULTIPLIER ON DELX,	XFACT2 = 0.2000E+01	L
GLOBAL_LOCATIONS_OF_X-VARIABLE	.ES	
1 2 3 4		
GLODAL_LOCATIONS_OF_FUNCTIONS	·	
7 6		
X-VECTORS INPUT_FROM_UNIT	5	
NUMBER 1 DESIGN 1		
0.2900E+020.1800E+020.150	0E+02 0.1100E+02	
NUMBER 2 DESIGN 2		
_0.2700E+020.1800E+020.150	0E+02 0.1100F+02	
0.100	VC V 1 # 1 U C T V C	
NUMBER 3 DESIGN 3		
0.2700E+02 0.1600E+02 0.150		
NUMBER 4 DESIGN 4		
0.2700E+020.1600E+020.130	0E+02 - 0.1100E+02	
NUMBER 5 DESIGN 5		
0.2700E+02_0.1600E+02_0.130	0E+02 0.9000E+01	
* * ESTIMATED DATA STORAGE RE		
REAL	INTEGER	
INPUT _ EXECUTION AVAILABLE		AVAILABLE
37 335 5000	26 71	1000
THEFT OF THE THEFT STREET STREET		

	SET VARE 1 TO	29.00 DEGREES		
		18.00 DEGREES		
		15.00 DEGREES	· · · · · · · · · · · · · · · · · · · 	
		11.00 DEGREES		
	HOLD RF:1C CONS HOLD DVS CONS EFFICIENCY=		5567.500 76.779	
	SURGE MARGIN=	8.2200		
4	新新新新新新 新光光光度 <mark>光度新新新新</mark>	***************		
	· **********	*******		
	SET VARE 1 TO	27.00 DEGREES		
	SET VANE 2 TO	18.00 DEGREES		
,	SET VANE 3 TO	15.00 DEGREES		
		11.00 DEGREES	•	
-	HOLD RENC CONST	TANT AT A VALUE OF	5567.500	
	HOLD DVS CONST	TANT AT A VALUE OF	76.779	
	EFFICIENCY=	87.3000		
_	SURGE MARGIN=	8.7900	and the state of t	
	**********	********		
-	SET VARE 1 TO	27.00 DEGREES		
		16.00 DEGREES		
	SET VANE 3 TO	15.00 DEGREES		
		11.00 DEGREES		
	HOLD REMC CONS	TANT AT A VALUE OF TANT AT A VALUE OF 87.2100	76.779	
_	SURGE MARGIN=		and a second of the second of	

	SET VANE 1 TO	27.00 DEGREES		
	SET VANE 2 TO	16.00 DEGREES		
	SET VARE 3 TO	13.00 DEGREES		
	SET VANE 4 TO	11.00 DEGREES		
_	HOLD RFI'C CONST	TANT AT A VALUE OF	5567.500	
	HOLD DVS CONST EFFICIENCY=	TANT AT A VALUE OF	76.779	
	SURGE MARGIN=			

	"非常其实不义义并并被称称的。	*****		

		 -									
	VANE 1										
	VARE 2										
	VANE 3										
SET	VANE 4	TO	9.0	0 0	EGREE	5	 -				
HOLD EFFI	DVS CIENCY	CONS =	TANT A	7 A	VALU			5567.50 76.71			
SURG	E MARG	IN=	9.2	400)						
AFPR	TAMIXO	E OP	ASIMIT	TIC	N ITE	MOITAS	HIST	TORY			
APPR	TAMIXO		FUNCTI	ON	1.3	ES THE	03J1	ECTIVE			
				ONS	ASSO	CIATED	ודוא	1 CCNST	RAINTS		
	CN VAR 1 2				ASSO	CIATED	HIT	1 APPRO	XIMATI	NG VARIAB	LES
BEGI	N ITER	ATIO	N NUMB	ER	1						
_ NO:1I	NAL DE	SIGN	NUMBE	R .=	5						
	2700 0E	+02	0.160					2 0.90	000E+0	1	
FUNC	TION V. 87420E	-			+01	***************************************				· · 	
RESU	LTS OF	APP	ROXIMA	TE	OPTIM	ZATIO	H				
	A-X VE										
		+41.	_ 0.111	965	.+61(J.2000	10 E+U J	L0.20	0002+0		
X-VE		+02	0.171	17E	+02 (.1100	0E+02	2 0.70	000E+0	1	
0.	CYIMAT 67300E	+02	0.999 ****	51E * 4 *	+01	**					
SET '	VANE 1	то		0 D		3					
SET	VANE_2	_TO_	_17.1	2 D	EGREES	3					
SET	VANE 3	то	11.0	0 D	EGREES	3					
SET	VANE_4	TO	7.0	0. D	EGREES	3					
HOLD HOLD _EFFI	RPMC (DVS (CIENCY	CONS	TANT A TANT A 87.5	T A T A 100	VALUE	OF OF	5	76.77	9		
	E MARG										
****	i i i i i i i i i i i i i i i i i i i i	***	****	***	****	·**					

-	inal design number = 6
X-V	ECTCR .25000E+02 0.17117E+02 0.11000E+02 0.70000E+0
_FUN	CTICN VALUES
	.87510E+02 0.94400E+01
. RES	ULTS OF APPROXIMATE OPTIMIZATION
DEL	TA-X VECTOR
0	.97329E+00 -0.20000E+01 -0.20000E+01 -0.20000E+0
	ЕСТСЯ
0	.25973E+02 0.15117E+02 0.90000E+01 0.50000E+0
	ROXIMATE FUNCTION VALUES
_	.87749E+02
SET	VARIE 1 TO 25.97 DEGREES
SET	VANE 2 TO 15.12 DEGREES
SET	VANE 3 TO 9.00 DEGREES
SET	VANE 4 TO 5.00 DEGREES
HOL	D RENC CONSTANT AT A VALUE OF 5567.500
HOL	D RENC CONSTANT AT A VALUE OF 5567.500 D DVS CONSTANT AT A VALUE OF 76.779 ICIENCY= 87.2800
	GE MARGIN= 9.6600
	公式 本元 技術 教養

	OTOS SINISTENI VALDIS
	CISE FUNCTION VALUES
Bec	IN ITERATION NUMBER 3
NCM	INAL DESIGN NUMBER = 7
	ECTCR
0	0.25973E+02
	CTICN VALUES
	.87280E+020.96600E+01

DELTA-X VECTOR 0.55595E+00 0.16977E+01 -0.20000E+01 -0.13585E-05
X-VECTO?
0.26529E+02 0.16814E+02 0.70000E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES
0.80094E+02 0.10006E+02
SET_VANE 1 TO _ 26.53 DEGREES
SET VARE 2 TO 16.81 DEGREES
SET_VAME 3 TO7.00 DESREES
SET VANE 4 TO 5.00 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500
HCLD DVS CONSTANT AT A VALUE OF 76.779
EFFICIENCY= 87.0800
SURGE MARGIN=9.4600
•

FRECISE FUNCTION VALUES
0.37030E+02 0.94600E+01
BEGIN ITERATION NUMBER 4
NOMINAL DESIGN NUMBER = 8
X-YECTOR 0.2559E+020.16814E+020.70000E+010.50000E+01
FUNCTION VALUES 0.87030E+02 0.94600E+01
0.073302702 0.748902701
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.80326E+00 -0.14797E+01 0.30000E+01 0.43284E-06
X-VECTCR 0.25726E+02_0.15335E+02_0.10000E+02_0.50000E+01
APPROXIMATE FUNCTION VALUES 0.87424E+02 0.96890E+01
び、ログルビルにすると ひ、700万により1 新鮮素素素素素素素素素素素素素素素素素素素素素素素素素素素素素
•
SET VANE 1 TO 25.73 DEGREES
SET VANE 2 TO 15.33 DEGREES
SET VANE 3 TO 10.00 DEGREES
SET VANS 4 TO 5.00 DEGREES
HOLD FPMC CONSTANT AT A VALUE OF 5567.500
HOLD EVS CONSTANT AT A VALUE OF 76.779
SURGE MARGIN= 9.6600
white a contract to the contra

PRECISE FUNCTION VALUES 0.87330E+02 0.96600E+01	
BEGIN ITERATION NUMBER 5	
NOMINAL DESIGN NUMBER =9	
X-VECTOR 0.25726E+02 0.15335E+02 0.10000E+02 0.50000E	+01
FUNCTION VALUES 0.07330E+02 0.96600E+01	
RESULTS OF APPROXIMATE OPTIMIZATION	
DELTA-X VECTOR 0.31007E+000.20260E+010.34839E+000.29043E	-06
X-VECTOR 0.25415E+02 0.13309E+02 0.96516E+01 0.50000E	+01
APPROXIMATE FUNCTION VALUES 0.37494E+02 0.97115E+01	
SET VANE 1 TO 25.42 DEGREES	
SET_VANE_2_TO13.31 DEGREES	
SET VANE 3 TO 9.65 DEGREES	
SET_VAME_4, TO5.00 DEGREES	
HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICITNOY= 87.2200	
SURGE MARGIN= 9.6900	
我我也们就让去你也会就被头好玩我也就我我你就就就就就就就就	
PRECISE FUNCTION VALUES	
BEGIN ITERATION NUMBER 6	
NOMINAL DESIGN NUMBER = 10	
X-VECTOR 0.25%15E+02 0.13309E+02 0.96516E+01 0.50000	E+01
FUNCTION VALUES 0.87220E+62 0.96900E+01	
RESULTS OF APPROXIMATE OPTIMIZATION	
DELTA-X VECTOR 0.10068E+00 0.48789E+00 0.45810E-01 0.64493	E-06
X-VECTCR 0.25516E+02 0.13796E+02 0.96974E+01 0.50000	
APPROXIMATE FUNCTION VALUES 0.87249E+02 C.96945E+01	

SET VANE 1 TO 25.52 DEGREES
SET VANE 2 TO 13.80 DEGREES
SET VANE 3 TO 9.70 DEGREES
SET VANE 4 TO 5.00 DEGREES
OLD RFIC CONSTANT AT A VALUE OF 5567.500 OLD DVS CONSTANT AT A VALUE OF 76.779 FFICIENCY= 87.2900
URGE MARGIN= 9.7700

RECISE FUNCTION VALUES _0.87290E+02 _0.97700E+01
EGIN_ITERATION_NUMBER7
OMINAL DESIGN NUMBER = 11
-VECTOR
0.25516E+02 0.13796E+02 0.96974E+01 0.50000E+0
UNCTION VALUES 0.07290E+02 0.97700E+01
ESULTS OF AFPROXIMATE OPTIMIZATION
ELTA-X VECTCR -0.95330E-01 -0.100005+01 0.11300E-01 0.0
-VECIDR 0.25420E+02 0.12796E+02 0.97087E+01 0.50000E+0
PFRONIMATE FUNCTION VALUES 0.07260E+02 0.97947E+01
ET VANE 1 TO 25.42 DEGREES
ET VANE 2 TO 12.80 DEGREES
ET_VANE_3_TO9.71. DEGREES
ET VANE 4 TO 5.00 DEGREES
OLD REMC CONSTANT AT A VALUE OF 5567.500
SURGE MARGIN=9.6100
: 新式剂放火 北京洋葡萄斯敦河流标准装置破壁的装置接通板的装置器

BEGIN ITERATION NUMBER 8
NOMINAL DESIGN NUMBER = 12
X-VECTOR 0.25420E+020.12796E+020.97087E+010.50000E+01
FUNCTION VALUES 0.87190E+02 0.96100E+01
RESULTS OF AFPROXIMATE OPTIMIZATION
X-VECTOR 0.25247E+020.14839E+020.99819E+010.50000E+01
APPROXIMATE FUNCTION VALUES 0.87334E+02 0.97163E+01
SET VANE 1 TO 25.25 DEGREES
SET VANE 2 TO 14.84 DEGREES
SET VANE 3 TO 9.98 DEGREES
SET VAME 4 TO 5.00 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD CVS CONSTANT AT A VALUE OF 76.779
EFFICIENCY= 87.3100
SURGE MARGIN= 9.8100
格林芳水 苏龙汉义长兴兴州城城城城城城城城城城城城城城城城城城城城城城城城城城城城城城城城城城城
FRECISE FUNCTION VALUES 0.87310E+02 0.98100E+01
BEGIN ITERATION NUMBER 9
NOMINAL DESIGN NUMBER = 13
X-VECTCR 0.25247E+02 0.14839E+02 0.99819E+01 0.50000E+01
FUNCTION VALUES 0.87510E+02 0.98100E+01
RESULTS OF AFFROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.22920E+01
X-VECTOR
0.22955E+02 0.14347E+02 0.10243E+02 0.50000E+01
AFFROXIBATE FUNCTION VALUES 0.87189E+02 0.99417E+01
の。0/10/10/64の

SET VANE 1 TO 22.96 DEGREES
SET_VANE_2_TO14.85_DEGREES
SET VANE 3 TO 10.24 DEGREES
SET_VANE_4_TO5.00_DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779EFFICIENCY= 87.3200
SURGE MARGIN= 9.9200
PPECISE FUNCTION VALUES 0.87320E+02 0.99200E+01
BEGIN ITERATION NUMBER 10
NOMINAL DESIGN NUMBER = 14
X-VECTOR
0.22955E+02 0.14847E+02 0.10243E+02 0.50000E+01
FUNCTION VALUES 0.67320E+02 0.99200E+01
RESULTS OF AFFROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.31324E+00 -0.12231E+00 -0.10000E+01 0.10213E-06
X-VECTCR 0.22642E+02 0.14725E+02 0.92434E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.87239E+02 0.99342E+01
SET VANE 1 TO 22.64 DEGREES
SET VANE 2 TO 14.72 DEGREES
SET VANE 3 TO 9.24 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 EFFICIENCY= 87.3800
SURGE MARGIN= 9.9800

PRECISE FUNCTION VALUES

FINAL RESULT OF APPROXIMATE OPTIMIZATION
NOMINAL DESIGN NUMBER = 15
X-VECTCR 0.22642E+02 0.14725E+02 0.92434E+01 0.50000E+01
FUNCTION VALUES 0.87390E+01
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION
GLOBAL LOCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X) 7 6
AFPROXIMATION IS BASED ON 15 DESIGNS
NCMINAL DESIGN IS DESIGN NUMBER 15
VALUES OF X-VARIABLES 0.2264E+02 0.1472E+02 0.9243E+01 0.5000E+01
VALUES OF FUNCTIONS, F(X) 0.673CE+02 0.998CE+01
COEFFICIENTS OF TAYLOR SERIES EXPANSION
PARAMETER 1 = GLOBAL VARIABLE 7
LINEAR TERMS, DEL F 0.3983E-01 0.3550E-01 0.5171E-01 0.7911E-01
NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT
ROW 1 0.6057E-03
RCN 2 0.8705E-02
ROH 3 0.2149E-01
ROW 4 -0.2440E-01
PARAMETER 2 = GLOSAL VARIABLE 6
LINEAR TERMS, DEL F -0.2371E-01 -0.7503E-00 -0.1890E-01 -0.3944E-01
NON-LINEAR_TERMS, H. BEGINING WITH DIAGONAL ELEMENT

ROW 1 -0.3965E-01 ROH 2 -0.6655E-01 -0.3313E-02 ROH 4 __ -0.1871E-03__ OPTIMIZATION RESULTS . CONTOUR FUNCTION .. GLOBAL LOCATION 7 FUNCTION VALUE 0.87380E+02 DESIGN VARIABLES _____ b. v. GLOBAL LOHER CI NO. VAR. NO. BOUND VALUE BCUND ____1 ...__0.10000E+02 ___0.22642E+02 ...0.350C0E+02... 0.50000E+01 0.14725E : 0.25000E+02 0.50000E+01 0.92434E+01 0.25000E+02 3 3 3 0.50000E+01 0.50000E+01 0.25000E+02 DESIGN CONSTRAINTS GLCDAL LCHER UPPER VALUE ID BOUND VAR. NO. BOUND 1 6 0.10000E+02 0.99800E+01 0.10000E+04 ****** FINAL SOLUTION VALUES ****** and a second control of the second control o VANE ANGLE FOR VANE 1 IS 22.64 DEGREES VANE ANGLE FOR VANE 2 IS _______ 14.72 DECREES _____ VANE ANGLE FOR VANE 3 IS 9.24 DEGREES VAME_ANGLE_FOR VAME 4 IS ______ 5.00 DEGREES__ EFFICIENCY= 87.3800 SURGE MARGIN=____9.9800____ RPHC WAS HELD CONSTANT AT 5567.50 DVS MAS HELD CONSTANT AT PROGRAM CALLS TO ANALIZ ICALC CALLS 15 1 2

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STATOR VANE OPTIMIZER

_PROTOTYPE_SOFTWARE CAPABLE OF GUIDING THE OPTIMIZATION OF ____

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

BY: PRATT & KHITNEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION

PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU

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17.		LAVE SEI	1	X				X	-		-	MIN	. I	

CORRECTED SPEED (RPMC) AND DISCHARGE VALVE SETTING (DVS) CONSTANT

WHILE CONSTRAINING EFFICIENCY TO A MINIMUM VALUE HOLD REMC CONSTANT AT 5567.500 HOLD DVS CCHSTANT AT 76.779 OPTIMIZING 4 VANE ANGLE(S)__ LCHER EQUND FOR VANE 1 IS 10.000 DO YOU AGREE? (Y/N) LOMER BOUND FOR VANE 2 IS DO YOU AGREE? (Y/N)_ LOWER EOUND FOR VANE 3 IS 5.000 DO YOU AGREE? (Y/N) LOWER BOUND FOR VANE 4 IS 5.000 __DO_YOU_AGREE? (Y/N)_ UPPER BOUND FOR VANE 1 IS 35.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 2 IS 25.000 DO YOU AGREE? (Y/N)

UPPER BOUND FOR VANE 3 IS 25.000

DO YOU AGREE? (Y/N)

UPPER BOUND FOR VANE 4 IS 25.000

DO YOU AGREE? (Y/N)

LCHER BOUND VALUE FOR EFF IS 87.300

UPPER BOUND VALUE FOR EFF IS 1000.000

INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTING IS ~2.00

123

MARCHINE PARK MARK-HOP PLLIC

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TITLE:
CONTROL PARAMETERS;
CALCULATION CONTROL,
                                NCALC =
NUMBER OF GLOBAL DESIGN. VARIABLES, ... NOV .=
NUMBER OF SENSITIVITY VARIABLES,
                                  NSV =
MURBER OF FUNCTIONS IN THO-SPACE,
                                * RAVSH
NUMBER OF APPROXIMATING VAR.
                               NXAPRX =
INPUT IMPORMATION PRINT CODE. _
                              _ IPNPUT =.
DEBUG PRINT CODE,
                                IFDBG =
CALCULATION CONTROL, NCALC _ _
VALUE MEANING
       SINGLE ANALYSIS
 1
       OPTIMIZATION
      _ SENSITIVITY
       THO-VARIABLE FUNCTION SPACE
       OPTIMUM SENSITIVITY
       APPROXIMATE OPTIMIZATION
* * OPTIMIZATION INFORMATION ..
GLCBAL VARIABLE NUMBER OF OBJECTIVE
MULTIPLIER (NEGATIVE INDICATES MINIMIZATION) = 0.1000E+01
CCHIIN PARAMETERS (IF ZERO, COMMIN DEFAULT WILL OVER-RIDE)
IPRINT ITMAX ICNDIR NSCAL ITRM LINCBJ NACMX1 NFDG
_ 5 ____ 20 ___ 5 ___ ._ 0.___
                              _ 3 _
                                  ____0 ____10 ____
               FOCHM
                              CT
                                             CTMIN
 0.10000E-01
               0.10000E-02
                             -0.50000E-01
                                             0.40000E-02
                             THETA
               CTLHIN
-0.10000E-01
               0.10000E-02
                              0.10000E+01
                                             0.0
                                        APOBJ1
                            __ALPHAX
            ____DABFUN
DELFUN
 0.10000E-02
               0.0
                              0.10000E+00
                                             0.10000E+00
DESIGN VARIABLE INFORMATION
NCH-ZERO INITIAL VALUE HILL OVER-RIDE MODULE INPUT
D. V.
         LCHER
                      UPPER
                                    INITIAL
         BOUND
                      BOUT:0
NO.
                                    VALUE
                                                  SCALE
                     0.35000E+02
       0.10000E+02
                                                 0.0
                                   0.27000E+02
 1
      0.50000E+01 ___ 0.25000E+02 ___ 0.16000E+02
                                                _0.0
                   0.25000E+02
0.25000E+02
       0.500005+01
                                  0.13000E+02
       0.50000E+01
                                   0.90000E+01
                                                 0.0
DESIGN VARIABLES
              GLOBAL
                        MULTIPLYING
     D. V.
10
      NO.
              VAR. NO.
                         FACTOR
                       _0.10000E+01
 2
                       0.10007E+01
 3
                       0.10000E+01
                       0.10000E+01
CONSTRAINT INFORMATION
NORMALIZATION
                                                         · UPPER
                                                                     NORMALIZATION
ID
     VAR. 1 VAR. 2
                    10
                               BOU:10
                                           FACTOR
                                                           BOUND
                                                                       FACTOR
                      0
                             0.87300E+02 0.87300E+02
                                                         0.10000E+04
                                                                       0.10000E+04
TOTAL NUMBER OF CONSTRAINED PARAMETERS = 1
```

				- M.
* * APPROXIMATE ANALYSIS/OPTI	MIZATIO	NI N	FORMATIC	7F1
NUMBER OF FUNCTIONS APPROXIMA	TED, NF	=	0	
NUMBER OF INFUT X-VECTORS,	NPS	. =	5	
NUMBER OF INPUT X-F PAIRS,			0	
X-VECTOR FROM ANALIZ,	NPA	=	0	
NOMINAL DESIGN,	HOME	=	0	
READ UNIT FOR X-VECTORS, READ UNIT FOR X-F PAIRS,	ISCRXF			
PRINT CONTROL,	IPAPRX	-	3	
TRIMI COMINGE)	27 77 77	_	•	
MINIMUM APPROXIMATING CYCLES.	KMIN	=	_5	
MAXIMUM APPROXIMATING CYCLES,	KMAX	=	17	
MAXIMUM DESIGNS USED IN FIT,	NFMAX	=	28	
NOMINAL DESIGN PARAMETER,	JNCM	=	28	
X-LOCATION INPUT PARAMETER.	THELOC		0	
F-LOCATION INFUT PARAMETER, TAYLER SERIES I.D. CODE,	MAYTON	=	2	
TATLER SERIES 1.D. COOL)	IIMATRII	-	•	
DELTA-X BOUNDS FOR APPROXIMAT	E OPTIM	EZAT	ION	
0.2000E+01 0.2000E+01 0.200	0E+01 (0.20	00E+01	
MULTIPLIER ON DELX,				
MULTIPLIER ON DELX,	XFACTE	=	0.2000E+	POT
GLOBAL_LOCATIONS_OF_X-YARIABL	.ES			
1 2 3 4				
GLOBAL_LOCATIONS OF FUNCTIONS	·			
6 7				
X-VECTORS INPUT FROM UNIT	5			
NUMBER 1 DESIGN 1				
0.2900E+020.1800E+020.150	OE+02!	0.11	00E+02_	
NUMBER 2 DESIGN 2				
0.2700E+020.1800E+020.150	0E+02	0.11	00E+02	
NUMBER 3 DESIGN 3				
0.2700E+020.1600E+020.150	0E+02 . (.11	00E+02 ~	
NUMBER 4 DESIGN 4				
0.2700E+020.1600E+020.130	0E+02 . (0.11	00E+02	
NUMBER 5 DESIGN 5				
0.27005+020.1600E+020.130	CE+02 1	90	DCE+01	
				· · · · · · · · · · · · · · · · · · ·
# # ESTIMATED DATA STORAGE RE	QUIREME	AL2		
REAL			INTEGER	
INPUT_EXECUTION AVAILABLE	INPU			. AVATLABLE
37 335 5000	26		71	1000
· · · · · · · · · · · · · · · · · · ·				
management with a second common and common a				
SET VANE 1 TO 29.00 DEGREES	1			
	ı			
SET VAME 2 TO 18.00 DEGREES	•			

The state of the s

SET VANE 3 TO	15.00 DEGREES	•
SET VANE 4 TO	11.00 DEGREES	
HOLD RPMC CONST		5567.500
HOLD DVS CONST SURGE MARGIN=	FANT AT A VALUE OF 8.2600	76.779
EFFICIENCY=	87.1400	
*****	**********	
*******	***********	
SET VANE 1 TO	27.00 DEGREES	
SET VANE 2 TO	18.00 DEGREES	
SET VANE 3 TO	15.00 DEGREES	
	11.00 DEGREES	
SURGE MARGINE		5567.500 76.779
EFFICIENCY=	87.3200	

	27.00 DEGREES	
SET VANE 2 TO	16.00 DEGREES	
	15.00 DEGREES	
	11.00 DEGREES	
HOLD BYS CONST SURGE MARGIN=		
EFFICIENCY=		

SET VANE 1 TO	27.00 DEGREES	
SET VAME 2 TO	16.00 DEGREES	
SET VANE 3 TO	13.00 DEGREES	
	11.00 DEGREES	
HOLD RPMC CONST	ANT AT A VALUE OF	5567.500
HOLD DVS CONST SURGE MARGIN=	TANT AT A VALUE OF 9.1200	76.779
EFFICIENCY=	87.2800	

SET VANE 1 TO 27.00 DEGREES
SET VANE 2 TO 16.00 DEGREES
SET VANE 3 TO 13.00 DEGREES
SET VANE 4 TO 9.00 DEGREES
HOLD RPHC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.1800
EFFICIENCY= 87.3300
APPROXIMATE OPTIMIZATION ITERATION HISTORY
APPROXIMATING FUNCTION 1 IS THE OBJECTIVE
APPROXIMATING FUNCTIONS ASSOCIATED WITH CONSTRAINTS 2
DESIGN VARIABLE NUMBERS ASSOCIATED WITH APPROXIMATING VARIABLES 1 2 3 4
BEGIN ITERATION NUMBER 1
NOMINAL DESIGN NUMBER =5
X-VECTOR 0.27000E+02 0.16000E+02 0.13000E+02 0.90000E+01
FUNCTION VALUES 0.91800E+01 0.87330E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.20000E+010.82847E+00 ~0.20000E+010.20000E+01
X-VECTOR
0.25000E+02 0.16828E+02 0.11000E+02 0.70000E+01
APPROXIMATE FUNCTION VALUES 0.99303E+01 0.87633E+02 ####################################
SET VANE 1 TO 25.00 DEGREES
SET_VANE_2_TO16.83 DEGREES
SET VANE 3 TO 11.00 DEGREES
SET_VANE_4_TO7.00 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DV3 CONSTANT AT A VALUE OF 76.779 SURSE MARGIN= 9.4800
EFFICIENCY= 87.5400
张斯斯斯卡尔认为地名英国伊斯斯斯斯特斯斯特斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯
PRECISE FUNCTION VALUES

BEGIN ITERATION	NUMBER 2		
NOMINAL DESIGN N			
X-VECTOR			
0.25000E+02 0	.16828E+02	0.11000E+02	0.70000E+01
FUNCTION .VALUES 0.94800E+01 0			
RESULTS . OF_ APPRO	XIMATEOPTIM	IZATION	
DELTA-X VECTOR 0.42508E+00 0	.84746E+00 -	0.2000CE+01	-0.20000E+01
X-VECTOR 0.25425E+02 0	.17676E+02	0.90000E+01	0.50000E+01
_APPROXIMATE. FUNC	TION VALUES		
0.97684E+01 0			
· 新新安州的共产州的 · · · · · · · · · · · · · · · · · · ·	쮺묫뀰提괡쬵꽘똣뇶윩춪	表表	
SET VANE 1 TO	25.43 DEGREE	5	
SET VANE 2 TO	17.68 DEGREE	s	
SET VANE 3 TO	9.00 DEGREE	5	
SET VANE 4 TO	5.00 DEGREE	5	
HOLD PPIC CONSTA	NT AT A VALU	E OF 55	67.500
HOLD DVS CONSTA			76.779
SURCE MARGIN=	9.6500		
EFFICIENCY=	87.370C		
***********	*****	K # #	
PRECISE FUNCTION			
0.96500E+010	.6/3/02+02		
BEGIN_ITERATION_	MIMRED 3		
			······································
NOMINAL DESIGN N	umber = 7		
_X-VECTOR 0.25425E+02 0	.17676E+02	0.9000E+01	0.50000E+01
FUNCTION VALUES			
RESULTS OF APPROX			
W MINNE			

DELTA-X VECTOR 0.18055E+01 -0.71106E+00 -0.20000E+01 -0.28566E-05
X-YECTCR 0.27231E+02 0.16965E+02 0.70000E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.10846E+02 0.89697E+02
SET.VANE.1 TO 27.23 DEGREES
SET VANE 2 TO 16.96 DEGREES
SET VANE 3 TO 7.00 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.4500
EFFICIENCY= 87.0500

PRECISE FUNCTION VALUES 0.94500E+01 0.87050E+02
BEGIN ITERATION NUMBER 4 HOMINAL DESIGN NUMBER = 8
X-VECTOR 0.27231E+02 0.16965E+02 0.70000E+01 0.50000E+01
FUNCTION VALUES 0.94500E+01 0.87050E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.26999E+01 -0.10758E+01 0.30000E+01 0.0
X-VECTOR 0.24531E+02_0.15889E+02_0.10000E+02_0.50000E+01
APPROXIMATE FUNCTION VALUES
0.98537E+01 0.87274E+02
SET VANE 1 TO 24.53 DEGREES
SET VANE 2 TO 15.89 DEGREES
SET VANE 3 TO 10.00 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779. SURGE MARGIN= 9.7900
EFFICIENCY= 87.4300
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PI	RECISE FUNCTION VALUES 0.97900E+01 0.87430E+02
В	EGIN ITERATION NUMBER 5
	OMINAL DESIGN NUMBER = 9
X-	-VECTOR 0.24531E+02 0.15889E+02 0.10000E+02 0.50000E+01
Fl	UNCTION VALUES 0.97900E+01 0.87430E+02
RI	ESULTS OF APPROXIMATE OPTIMIZATION
	ELTA-X VECTOR -0.13657E+010.30000E+010.12498E+000.71604E+00
X-	-VECTCR 0.23165E+02
	PPROXIMATE FUNCTION VALUES 0.10994E+02 0.87442E+02
SE	ET VANE 1 TO 23.16 DEGREES
56	ET_VANE_2_TO12.89_DEGREES
SE	ET VANE 3 TO 9.88 DEGREES
5	ET_VANE 4_TO5,72_DEGREES
HC	DLD RFMC CONSTANT AT A VALUE OF 5567.500 DLD DVS CONSTANT AT A VALUE OF 76.779 URGE MAFGIN= 9.9800
EF	FFICIENCY= 87.2700
***	· 油板灰板硬盖铸罐地流水板破污筒污架放板水夹板的铁板
P	RECISE FUNCTION VALUES
В	EGIN ITERATICH NUMBER 6
N	CMINAL DESIGN NUMBER = 10
	-VECTOR 0.23165E+02 0.12889E+02 0.98750E+01 0.57160E+01
F	UNCTION VALUES
R	ESULTS OF APPROXIMATE OPTIMIZATION
D	ELTA-X VECTOR 0.52440E+00 0.58893E+00 0.98662E+00 -0.71604E+00
×	-VECTOR
	0.23689E+02 0.13478E+02 0.10862E+02 0.50000E+03

SET VANE 1 TO 23.69 DEGREES
SET VANE 2 TO 13.48 DEGREES
SET VANE 3 TO 10.86 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.8400
EFFICIENCY= 87.3000
植物植物物质 建设计 不安全 化克克斯 化水水 化水水 化水水水 化水水水 化水水 电电
PRECISE FUNCTION VALUES
BEGIN_ITERATION_NUMBER7
NOMINAL DESIGN NUMBER = 11
X-VECTOR_
0.23689E+02 0.13478E+02 0.10862E+02 0.50000E+01
FUNCTION VALUES 0.98400E+01
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.14401E+01 0.74872E+00 -0.29438E+01 0.29881E+01
X-VECTOR 0.22249E+02 0.14227E+02 0.79178E+01 0.79881E+01
APPROXIMATE FUNCTION VALUES 0.99002E+01 0.87495E+02
株型銀貨の大部内の大型製料が発生を発展する。 カップ 大型
SET VANE 1 TO 22.25 DEGREES
SET VANE 2 TO 14.23 DEGREES
SET VAME 3 TO7.92 DEGREES
SET VANE 4 TO 7.99 DEGREES
HOLD RFMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGINE 9.9000
EFFICIENCY= 67.3000
我就我我就我我我我我我我我我我我我我我我我我我我我我我我我我我我我我我我我
PRECISE FUNCTION VALUES 0.99000E+01 0.8730CE+02

BEGIN ITERATION NUMBER 8
NOMINAL DESIGN NUMBER = 12
X-VECTOR 0.22249E+02_0.14227E+02_0.79178E+01_0_79881E+01
FUNCTION VALUES 0.99000E+01 0.87300E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.31456E+00 0.25967E+00 0.62168E+00 -0.27062E+01
X-VECTOR 0.22564E+020.14486E+020.85395E+010.52819E+01
APPROXIMATE FUNCTION VALUES 0.99291E+01 0.87331E+02
SET VANE 1 TO 22.56 DEGREES
SET VANE 2 TO 14.49 DEGREES
SET VAME 3 TO 8.54 DEGREES
SET VANE 4 TO 5.28 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CCHSTANT AT A VALUE OF
EFFICIENCY≈ 87.3600
操務機構所求於與實施機構機構與與關係的政策的
PRECISE FUNCTION VALUES 0.99700E+01 0.87360E+02
BEGIN ITERATION NUMBER 9
NOMINAL DESIGN NUMBER = 13
X-VECTO? 0.22554E+02 0.14486E+02 0.85395E+01 0.52819E+01
FUNCTION VALUES 0.99700E+01 0.87360E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.26179E+00 -0.69402E-01_0.10623E+000.28189E+00
X-VECTOR
0.22302E+02 0.14417E+02 0.86457E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.99761E+01 0.87370E+02
뺶쁅쁔혂뿄횼ҥ쒸됮댸첀윉궑쭏짫첀짫짫짫짫뚔윉윉냋퓛됮쳁첉첉첉

	14.42 DEGREES
	8.65 DEGREES
SET_VANE_4_TO	5.00 DEGREES
	STANT AT A VALUE OF 5567.500 STANT AT A VALUE OF 76.779 10.0100
EFFICIENCY=	87.3200

PRECISE FUNCT: 0.10310E+02	ION VALUES
BEGIN ITERATIO	ON NUMBER 10
	N NUMBER = 14
X-VECTO?	
	0.14417E+02 0.86457E+01 0.50000E+0
FUNCTION VALUE	ES
	C.87320E+02
DELTA-X VECTOR	PROXIMATE OPTIMIZATION
DELTA-X VECTO: -0.14109E+00	2
DELTA-X VECTOR	R -0.50324E-01 0.14968E-01 0.58275E-00
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02	R -0.50324E-01 0.14968E-01 0.58275E-00
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FE	0.14367E+02 0.86607E+01 0.50000E+0
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FU 0.10010E+02	R -0.50324E-01 0.14968E-01 0.58275E-00 0.14367E+02 0.86607E+01 0.50000E+0
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FOR 0.10010E+02	R -0.50324E-01 0.14968E-01 0.58275E-00 0.14367E+02 0.86607E+01 0.50000E+01 0.67321E+02
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FOR 0.10010E+02 ***********************************	R -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+0 UNCTION VALUES 0.87321E+02
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FU 0.10010E+02 ***********************************	R -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+0: UNCTION VALUES 0.87321E+02 ************************************
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FOR SET VANE 1 TO SET VANE 2 TO SET VANE 3 TO SET VANE 4 TO	7 -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+0: UNCTION VALUES 0.87321E+02 ************************************
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FU 0.10010E+02 WWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW	-0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+03 UNCTION VALUES 0.87321E+02 ***********************************
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FOR O.10010E+02 WHENEVER TO SET VANE 1 TO SET VANE 2 TO SET VANE 3 TO SET VANE 4 TO HOLD RPMC CONSHOLD DVS CONS	7 -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+03 UNCTION VALUES 0.87321E+02 ************************************
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FU 0.10010E+02 ***********************************	7 -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+03 UNCTION VALUES 0.87321E+02 ************************************
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FOR O.10010E+02 ***********************************	R -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+02 UNCTION VALUES 0.87321E+02 ************************************
DELTA-X VECTOR -0.14109E+00 X-VECTOR 0.22160E+02 APPPOXIMATE FE 0.10010E+02 ***********************************	R -0.50324E-01 0.14968E-01 0.58275E-06 0.14367E+02 0.86607E+01 0.50000E+02 UNCTION VALUES 0.87321E+02 ************************************

BEGIN_ITERATION NUMBER11
NOMINAL DESIGN NUMBER = 15
X-VECTOR
0.22160E+02 0.14367E+02 0.86607E+01 0.50000E+01
FUNCTION VALUES
0.10020E+020.87310E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.92877E-01 -0.16467E-01 0.23182E-02 0.0
X-VECTOR
0.22067E+02 0.14350E+02 0.86630E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES
0.10020E+02
新架款式将款买买货货货货票买货货货货货货货货
SET_VANE_1_TO22.07 DEGREES
del Trine & My Selvy Decited
SET VANE 2 TO 14.35 DEGREES
SET_VANE_3_TO 8.66 DEGREES
SET VANE 4 TO 5.00 DECREES
HOLD RPMC CONSTANT AT A VALUE OF5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779
SUNGE MARGINE 9.9200
EFFICIENCY=87.3200

PRECISE FUNCTION VALUES
0.99200E+01 0.87320E+02
And the state of t
BEGIN ITERATION NUMBER 12
NOMINAL DESIGN NUMBER = 16
X-VECTOR
0.22067E+020.14350E+020.86630E+010.50000E+01
PANARTTAL LIAITE
FUNCTION VALUES 0.99200E+01 0.87320E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
0.90472E+00 0.24113E+00 0.33393E+00 0.76387E-01
X-VECTOR
0.22972E+02 .0.14591E+02 .0.89970E+01 -0.50764E+01
AFFROXIMATE FUNCTION VALUES
0.99321E+01 0.87341E+02

SET VANE 1 TO 22.97 DEGREES
SET VANE 2 TO 14.59 DEGREES
SET VANE 3 TO 9.00 DEGREES
SET VANE 4 TO 5.08 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 9.9000
EFFICIENCY= 87.3900
·
PRECISE FUNCTION VALUES 0.99000E+01 0.87390E+02
BEGIN ITERATION NUMBER 13
NOMINAL DESIGN NUMBER =17
X-VECTOR 0.22972E+02 0.14591E+02 0.89970E+01 0.50764E+01
FUNCTION VALUES 0.99000E+01 0.87390E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.53803E+000.10465E+000.24495E-010.76386E-01
X-VECTOR 0.22434E+02 0.14487E+02 0.90215E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.99036E+01 0.87397E+02
SET VANE 1 TO 22.43 DEGREES
SET VAME 2 TO14.49 DEGREES
SET VANE 3 TO 9.02 DEGREES
SET VANE 4 TO 5.00 DECREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779SURCE MARGIN= 9.9600
EFFICIENCY= 87.3400
一 被被避免所谓污染效益或抗抗性抗性性抗性性疾病疾病疾病疾病疾病疾病
PRECISE FUNCTION VALUES 0.975C0E+01 0.87340E+02
BEGIN ITERATION NUMBER 14
NCMINAL DESIGN NUMBER = 18

X-VECTOR
0.22434E+02 0.14487E+02 0.90215E+01 0.50000E+01
FINISTING MALLIPO
FUNCTION VALUES
0.770UUETUI U.O/340ETUZ
RESULTS OF APPROXIMATE OPTIMIZATION
5-1-1 W 115-15-1
DELTA-X VECTOR
0.10636E+00 0.82121E-01 -0.61548E-01 0.20496E-06
X-VECTCR
0.22540E+02 0.14569E+02 0.89599E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES
0.99502E+01 0.87340E+02
SET VANE 1 TO 22.54 DEGREES
OPE WALL A TO 14 PT DEAD
SET VANE 2 TO 14.57 DEGREES
SET VANS 3 TO 8.96 DEGREES
e re erre esemble
SET VANE 4 TO 5.00 DEGREES
Hall Boys Colleges of the Coll
HOLD RPMC CONSTANT AT A VALUE OF 5567.500
HOLD DVS CONSTANT AT A VALUE OF 76.779 SURGE MARGIN= 10.0300
SCHOL HAROTHA TO-0300
EFFICIENCY= 87.3400
· · · · · · · · · · · · · · · · · · ·
The second secon
PRECISE FUNCTION VALUES
0.10230E+02
BEGIN ITERATION NUMBER 15
NOMINAL DESIGN NUMBER = 19
X-VECTOR
0.22540E+02 0.14569E+02 0.89599E+01 0.50000E+01
FUNCTION VALUES
0.10030E+C2
RESULTS OF APPROXIMATE OPTIMIZATION
RESOLIS OF APPROXIMATE OF INTERACTION
DELTA-X VECTOR
-0.65381E+00 0.13942E+00 -0.15637E+00 0.37472E-06
W MEGTAT
X-YECTOR
0.210000702 0.14/000702 0.080355401 0.500005401
APPROXIMATE FUNCTION VALUES
0.10335E+02 0.87350E+02

SET_VANE 1 TO21.89 DEGREES
JET. YMNS I,IU, LEIKOT DEUREED,
SET VANE 2 TO 14.71 DEGREES

SET VANE 3 TO 8.80 DEGREES	_
SET VANE 4 TO 5.00 DEGREES	
HOLD RPMC CONSTANT AT A VALUE OF 5567.500	
HOLD DVS CONSTANT AT A VALUE OF 76.779	
SURGE MARGIN= 9.9900	
_EFFICIENCY=87.3100	
美长关关键基准严税等的转换整整规模的转换矩阵并光线接触的矩阵	
PRECISE FUNCTION VALUES 0.99900E+01 0.87310E+02	
BEGIN ITERATION NUMBER 16	
NOMINAL DESIGN NUMBER = 20	
X-VECTOR 0.21996E+020.14708E+020.88035E+010.50000E	+01
FUNCTION VALUES 0.99900E+01 0.87310E+02	
RESULTS OF APPROXIMATE OPTIMIZATION	
_DELTA-X VECTOR	-06
X-VECTOR 0.22337E+02 0.14543E+02 0.88687E+010.50000E	+01.
APPROXIMATE FUNCTION VALUES 0.99925E+01 0.87315E+02 ************************************	
SET VANE 1 TO 22.34 DEGREES	
SET VANE 2 TO 14.54 DEGREES	
SET VAME 3 TO 8.87 DEGREES	
SET VANE 4 TO 5.00 DEGREES	
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURCE MARGIN= 10.0900	
EFFICIENCY= 87.3200	
*********	<u></u>
PRECISE FUNCTION VALUES 0.10090E+02 0.87320E+02	
BEGIN ITERATION NUMBER 17	
NOMINAL DESIGN NUMBER = 21	

FUNCTION VALUES 0.10090E+02 0.87320E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0_15458E+010.61068E+000.32988E+000,50180E-06
X-VECTOR 0.20791E+02 0.15154E+02 0.91986E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.10122E+02 0.87355E+02 ************************************
SET VANE 1 TO 20.79 DEGREES
SET. VANE 2 TO 15.15 DEGREES
SET VANE 3 TO 9.20 DEGREES
SET_YANE 4 TO5.00 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD DVS CONSTANT AT A VALUE OF 76.779 SURCE MARGIN= 10.0000
EFFICIENCY= 87.2600

PRECISE FUNCTION VALUES
FINAL RESULT OF APPROXIMATE OPTIMIZATION
La = 21 PALIMON ALICE
X-VECTOR 0.22337E+02 0.14543E+02 0.88687E+01 0.50000E+01
_FUNCTION VALUES 0.10090E+02 0.87320E+02
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION
TITLE ************************************
GLOBAL LCCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X) 6 7
APPROXIMATION IS BASED CN 22 DESIGNS
NOMINAL DESIGN IS DESIGN NUMBER 21
VALUES OF X-VARIABLES 0.2234E+02 0.1454E+02 0.8869E+01 0.5000E+01

ROW 0.26	4 57E-01				
		GLOBAL VAR	TABLE 7		- <u>-</u>
0.26	57E-01				
_					
ROH 70.16					
	2 43E-01				
ROW					
					
		·			
					
_					
_					
v.c0	· · · · ·				
0.19	70E-01	0.6028E-01	0.4993E-01	0.4308E-01	
_KOH-LIK	EAR _TERMS	0.6028E-01	0.4993E-01 NG WITH DIAGON		
_NON-LIK	EAR _TERMS	0.6028E-01	0.4993E-01		
_NON-LIN	EAR _TERMS 1 74E-01	0.6028E-01	0.4993E-01		
NON-LIN	EAR _TERMS 1 74E-01	0.6028E-01	0.4993E-01		
NON-LIN	EAR _TERMS 1 74E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11	EAR _TERMS 1 74E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11	EAR _TERMS 1 74E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 -0.11 ROW -0.11	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01	0.6028E-01	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 -0.11 ROW -0.11	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01	0.6028E-01	0.4993E-01		
ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11 ROW -0.14 OPTIMIZ	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 -	O.6028E-01 6,_H,_BEGINI	0.4993E-01		
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11 OPTIMIZ	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 _ ATION RES	0.6028E-01 6,_H,_BEGINI	0.4993E-01	AL_ELEMENT	
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11 OPTIMIZ	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 -	0.6028E-01 6,_H,_BEGINI	0.4993E-01	AL_ELEMENT	
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11 OPTIMIZ	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 _ ATION RES	0.6028E-01 6,_H,_BEGINI	0.4993E-01	AL_ELEMENT	
ROW -0.27 ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.14 OPTIMIZ CSJECTI' GLODAL	EAR _TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 _ ATION RES	0.6028E-01 6,_H,_BEGINI 6 FU	0.4993E-01	AL_ELEMENT	
ROW -0.27 ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.14 OPTIMIZ CSJECTI' GLODAL	EAR TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 ATION RES VE FUNCTI	0.6028E-01 6, H, BEGINI 6 FU	0.4993E-01 NG WITH DIAGON	AL_ELEMENT	
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11 COUNTY COU	EAR TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 ATION RES VE FUNCTI LOCATION VARIABLES 0. V.	O.6028E-01 GULTS GLCBAL	0.4993E-01 NG WITH DIAGONA NCTION VALUE 0 LOWER	AL_ELEMENT	UPPER
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.11 COJICTE GLODAL DESIGN	EAR TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 ATION RES VE FUNCTI LOCATION VARIABLES D. V.	O.6028E-01 GLCBAL VAR. NO.	0.4993E-01 NG WITH DIAGONA NCTION VALUE 0 LOWER BOUND	AL_ELEMENT	BOUND
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 RCW -0.14 OPTIMIZ CSJECTU GLODAL DESIGN	EAR TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 ATION RES VE FUNCTI LOCATION VARIABLES 0. V.	O.6028E-01 GULTS GLCBAL	0.4993E-01 NG WITH DIAGONA NCTION VALUE 0 LOWER BOUND	AL_ELEMENT	BOUND
NON-LIN ROW -0.27 ROW -0.11 ROW -0.11 ROW -0.14 OPTIMIZ CSJECTI GLODAL DESIGN	EAR TERMS 1 74E-01 2 14E-01 3 44E-01 4 71E-01 ATION RES VE FUNCTI LOCATION VARIABLES D. V. NO.	O.6028E-01 G.H., BEGINI GN GLCBAL VAR. NO.	0.4993E-01 NG WITH DIAGONA NCTION VALUE 0 LOWER BOUND0.10000E+02	AL_ELEMENT10090E+02 VALUE _0.22337E+02	BOUND 0.35000E+02

DESIGN CONSTRAINTS

70	GLOBAL	LOWER	VALUE	UPPER	
i i	7	0.67300E+02	0.87320E+02	0.10000E+04	
		LUTION VALUES	******		
			22.34 DEGREES		
VANE_ANGL	E_FOR_VANE.	2_IS	_14.54_DEGREES_		
VANE ANGLE	E FOR VANE	3 IS	8.87 DEGREES		
YAHE_ANGL	E_FOR_VANE	4_IS	5.00.DEGREES_		
SURGE MAR	GIN= 10.0	900			
EFFICIENC	Y=87.1	3200	 	 	
	HELD CONSTA	TA THE	556 7.50 76.78		
FROGRAM C	ALLS TO ANA	LIZ			
ICALC	CALLS				
2					

STATOR VANE OPTIMIZER ***** PROTOTYPE SOFTWARE CAPABLE OF GUIDING THE OPTIMIZATION OF STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMFRESSOR FREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY UNDER CONTRACT F33615-79-C-2013 BY: PRATT & WHITNEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU I CPTIMIZATION CONDITICNS I CONSTRAINTS I NO I GOAL I REMO WO FR DVS O.L. I S.M. I EFF IX I -1 7 EFF I X I - ... 2 I EFF I X _ Х I I -3 I EFF I X X _ -EFF I X Х I MIN I 5 I _ EFF 6 I EFF - I . × ____ I HIN 1_ X X I MIN 7 I S.H. I X X T 3 I S.M. I X X I I x_ ,x ,_.. 9 I S.M. I 0 I S.M. I I - I -10 I Х X I 11 I S.M. I X I MIN X 12 I S.M. I I MIN 13 I SHIELD I X 14 I MAX NO I x I MIN I HIN X 15 I HIN HC I X Х I MIN I MIN 16 I FR I X Х I MIN I MIN PR I X I MIN I MIN YOU HAVE SELECTED TO MAXIMIZE CORRECTED FLOW HOLDING CORRECTED SPEED (RPMC) AND OPERATING LINE (OL) CONSTANT WHILE CONSTRAINING SURGE MARGIN AND EFFICIENCY TO MINIMUM VALUES HOLD RENC CONSTANT AT 5567.500 HOLD OL CONSTANT AT OPTIMIZING 4 VANE ANGLE(S) LOHER BOUND FOR VAME 1 IS 10.000 DO YOU AGREE? (YZN) LOWER BOUND FOR VANE 2 IS 5.000 DO YOU AGREE? (Y/N) LOWER DOUND FOR VALLE 3 IS 5.000 DO YOU ACREE? (Y/N) LOMER BOUND FOR VANE 4 IS 5.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 1 IS 35.000 DO YOU ACREE? (Y/N) UPPER BOUND FOR VANE 2 IS 25.000 DO YOU AGREE? (Y/N) UPPER SCUND FOR VANE 3 IS DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 4 IS 25,000 DO YOU AGREE? (Y/N) LOHER BOUND VALUE FOR SM İIS 8.500 UPPER DOUGH VALUE FOR SM IS 100.000 LCHER BOUND VALUE FOR EFF IS 87.000 UPPER BOUND VALUE FOR EFF IS 1000.000

INCREMENTAL VANE ANGLE VALUE FOR INITIAL VANE SETTING IS

CONSTRAINT INFORMATION

THER	E_ARE GLC VAR	2 L .	CONSTRAIN GLOBAL VAR. 2	NT SETS Linear Id	LON	ER ND	NORMALIZATION FACTOR 0.85000E+01	UPPER BOUND	NORMALIZATION FACTOR
1		6 7	6 7	0	0.850	00E+01	0.85000E+01 0.87000E+02_	0.100000+03	0.10000E+03
			OF CONSTI						0.100002.00
* *	APPRO	XIHA	TE ANALY	SIS/OPTIM	 NIZATION	INFORM	MATION		
			CTIONS A						
NU:12	ER OF	INF	'UT X-VEC	TCRS,	NPS	= 5			
KUHS	ER OF	INF	UT X-F P	AIRS,	NPFS	= 0			
X-VE	CTC3	FRC*	UT X-F P		KPA	= 0			
THON	NAL D	ESIG	₩,		ROMI	= 0			
READ	URIT	FCR	X-VECTO	₹\$,	ISCRX	= 5			
READ PRIN	UNIT T CON	FCR TROL	X-VECTO	₹5,	ISCRXF IPAFRX	= 5			
			XIMATING						
			XIMATING						
MAXI	TICH D	5216	NS USED	IN F11,					
KOUT	KAL D	F210	H PARAME	IER,	HOH	= 28			·
X-10	CATIO	14 TZ:	FUT PARAL	NEIER)	INALCC	- 0			
			MUT PARAL						
JAIL	CK SE	RILL	1.0. 00:) = ,	HAATKII				
			DELX,						in age comings a for transportation and the contract of a section of the contract of the contr
			CNS OF X	-VARIABLE	s	_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
	AÉ LC 8		CHS OF FI	HICTIONS					
X-VE	CTORS	INF	UT FROM (JNIT 5	···				
NUMB	ER 00E+0	2 _0	DESIG	N 1 2 0.1500	E+02 0	.1100E+	02		
NUMB	ER	2	DESIG	1 2					
0.27	00E+0	2 0	.1800E+0	2 0.1500	E+02 0	.1100E+	02		
			DESIG		E+02 0	.1100E+	02		
			DESIG		E+02 0	.1100E+	02		
			DESIG .1600E+0;		E+02 Ö	. 9000E+	01		

* * ESTIMATED DATA STORAGE REQUIREMENTS

REAL INPUT EXECUTIO 41 355 ***********************************	5000	INTEGER INPUT EXECUTION 30 78	AVAILABLE 1000
SET VANE 1 TO	29.00 DEGREES		
SET_VANE 2 TO	_18.00 DEGREES		
SET VANE 3 TO	15.00 DEGREES		
SET_VANE_4_TO	11.00 DEGREES		
HOLD OL CONST	ANT AT A VALUE OF ANT AT A VALUE OF 77.5200	5567.500 F 76.779	
SURGE MARGIN=	8.2800		
EFFICIENCY=	87.1400		
经延迟证据并未 证据的证据	******		
***************************************	ਸ਼ ਜ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਸ਼ਜ਼ਸ਼		
SET VANE 1 TO	27.00 DEGREES		
SET VANE 2 TO	18.00 DEGREES		
SET VANE 3 TO	15.00 DEGREES		
SET VANE 4 TO	11.00 DEGREES		
HOLD RPMC CONST HOLD OL CONST CORPECTED FLOWS		5567.500 76.779	
SURGE MARGIN=	8.7700		
EFFICIENCY=	87.3200		
我帮诉我就 我就来来来来就就要的	*****		•
**********	*****		
SET VANE 1 TO	27.00 DEGREES		
SET_VANE_2_TO_	_16.00 DEGREES		_
SET VANE 3 TO	15.00 DEGREES		
SET_VANE 4 TO	_11.00 DEGREES		_
HOLD RPMC CONST HOLD OL CONST CORRECTED FLONE	AHT AT A VALUE OF AHT AT A VALUE OF 78.7800	5567.500 76.779	-
SURGE MARGIN=			
EFFICIENCY=	87.2500		

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SET VANE 1 TO 27.00 DEGREES
SET VANE 2 TO 16.00 DEGREES
SET VANE 3 TO 13.00 DEGREES
SET VANE 4 TO 11.00 DEGREES
HOLD RPITC CONSTANT AT A VALUE OF 5567.500 HOLD CL CONSTANT AT A VALUE OF 76.779 CORRECTED FLON= 79.1900
CORRECTED FLOW= 79.1900
SURGE MARGIN= 8.9700
EFFICIENCY= 87.3000
被据米娅米迪米米米斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯

SET VANE 1 TO 27.00 DEGREES
SET VANE 2 TO 16.00 DEGREES
SET VANE 3 TO 13.00 DEGREES
SET VANE 4 TO 9.00 DEGREES
HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD CL CONSTANT AT A VALUE OF 76.779 CONRECTED FLOW= 79.4900
SURGE MARGIN= 9.2000
EFFICIENCY= 67,3300
新州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州州
APPROXIMATE OPTIMIZATION ITERATION HISTORY
APPROXIMATING FUNCTION 1 IS THE OBJECTIVE
AFFROXIMATING FUNCTIONS ASSOCIATED WITH CONSTRAINTS 2 3
DESIGN VARIABLE NUMBERS ASSOCIATED WITH APPROXIMATING VARIABLES 1 2 3 4
BEGIN ITERATION NUMBER 1
NOTITIAL DESIGN NUTBER = 5
X-VECTOR 0.27000E+02 0.16000E+02 0.13000E+02 0.90000E+01
FUNCTION VALUES 0.79493E+02 0.92000E+01 0.87330E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.20000E+01 -0.20000E+01 -0.20000E+01 -0.20000E+01

X-VECTCR 0.25000E+02 0.14000E+02 0.11000E+02 0.70000E+01
APFROXIMATE FUNCTION VALUES 0.81460E+02 0.10120E+02 0.87520E+02
SET VANE 1 TO 25.00 DEGREES
SET VANS 2 TO 14.00 DEGREES
SET VANE 3 TO 11.00 DEGREES
SET VANE 4 TO 7.00 DEGREES
HOLD RAMC CONSTANT AT A VALUE OF 5567.500 HOLD CL CONSTANT AT A VALUE OF 76.779 CCRRECTED FLON= 81.2800
SURGE MARGIN= 9.6700
EFFICIENCY= 87.4000

FRECISE FUNCTION VALUES 0.81280E+02 0.96700E+01 0.87400E+02
BEGIN ITERATION NUMBER 2
NOMINAL DESIGN NUMBER = 6
X-VECTOR 0.25300E+02 0.14000E+02 0.11000E+02 0.70000E+01
FUNCTION VALUES 0.81280E+02 0.96700E+01 0.87400E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.19352E+01 -0.12170E+01 -0.20000E+01 -0.20000E+01
X-VECTOR 0.23065E+02 0.12783E+02 0.90000E+01 0.50000E+01
AFFROXIMATE FUNCTION VALUES 0.82731E+02 0.95947E+01 0.87381E+02
SET VANE 1 TO 23.06 DEGREES
SET VANE 2 TO 12.78 DEGREES
SET VANE 3 TO 9.00 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLORE 82.7400
SURGE MARGIN= 9.9900
EFFICIENCY= 87.2500

. # # i	· · · · · · · · · · · · · · · · · · ·
	ECISE FUNCTION VALUES 0.32740E+02 0.99900E+01 0.87250E+02
B&(GIN ITERATION NUMBER 3
	TINAL DESIGN NUMBER = 7
	VECTOR 0.23065E+02 0.12783E+02 0.9000E+01 0.50000E+01
	CCTION VALUES 0.82740E+02 0.99900E+01 0.87250E+02
RE	SULTS OF APPROXIMATE OFTIMIZATION
OP.	TIMIZATION HAS PRODUCED AN X-VECTOR WHICH IS THE SAME AS A PREVIOUS DESIG
	LTA-X VECTOR
•	0.84360E-06 -0.56198E-05 -0.40702E-05 -0.29150E-05
	VECTOR 0.23065E+02 0.12783E+02 0.90000E+01 0.50000E+01
THI	E FOLLOWING DESIGN IS NOT THE APPROXIMATE OPTIMUM
DE	LTA-X VECTOR 0.60001E-01 0.59994E-01 0.39996E-01 0.19997E-01
,	0.60001E-01 0.59994E-01 0.39996E-01 0.19997E-01
	VECTOR 0.23125E+02
(PROXIMATE FUNCTION VALUES 0.82704E+02
SET	T VANE 1 TO 23.12 DEGREES
SE	T VANE 2 TO 12.64 DECREES
	T VANE 3 TO 9.04 DECREES
SET	T VANE 4 TO 5.02 DEGREES
HOI	LD RUNC CONSTANT AT A VALUE OF 5567.500 LD OL CONSTANT AT A VALUE OF 76.779
CO.	RRECTED FLOM= 02.7100
SU:	RGE MARGIN= 9.9700
- EFF	FICIENCY= 87.2600

BEGIN ITERATION NUMBER 4
NOMINAL DESIGN NUMBER = 8
X-VECTOR 0.23125E+02 0.12843E+02 0.90400E+01 0.50200E+01
FUNCTION VALUES 0.82710E+02 0.99700E+01 0.87260E+02
0.02/102402 0.77/002402
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
0.27535E+00 -0.10000E+01 -0.49622E+00 -0.20002E-01
X-VECTOR
0.23400E+02 0.11843E+02 0.85438E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.83101E+02 0.85726E+01 0.87614E+02
*#**
SET VANE 1 TO 23.40 DEGREES
SET VANE 2 TO 11.84 DEGREES
SET VANS 3 TO 8.54 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLON= 62.8800
SURGE MARGIN= 10.1000
EFFICIENCY= 87.2000
新芳州州州北京大大江州大大大大大大大大大大大大大大大大大大
PRECISE FUNCTION VALUES 0.82030E+02 0.10100E+02 0.87200E+02
BEGIN ITERATION NUMBER 5
NOMINAL DESIGN NUMBER = 9
X-VECTOR
0.23400E+02 0.11343E+02 0.85438E+01 0.50000E+01
FUNCTION VALUES
0.32850E+02 0.10100E+02 0.87200E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.67223E+00 -0.30000E+01 0.35910E+00 0.48671E+00
X-VECTOR 0.22728E+02 0.88430E+01 0.89029E+01 0.54367E+01
APPROXIMATE FUNCTION VALUES

0.83304E+02 0.85494E+01 0.87775E+02 SET VANE 1 TO 22.73 DEGREES SET VANE 2 TO 8.84 DEGREES SET VARE 3 TO 8.90 DEGREES SET VANE 4 TO 5.49 DEGREES HOLD RAME CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOHE 83.3600 SURGE MARGIN= 9.9100 EFFICIENCY= 87.0000 *********** PRECISE FUNCTION VALUES 0.83360E+02 0.99100E+01 0.87000E+02 EEGIN ITERATION NUMBER NOMINAL DESIGN NUMBER = 10 X-VECTOR FUNCTION VALUES 0.83360E+02 0.99100E+01 0.87000E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR 0.33795E+00 -0.12499E+01 -0.82012E-01 -0.48670E+00 X-VECTOR 0.23116E+02 0.75931E+01 0.38209E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.83616E+02 0.8563E+01 0.87463E+02 SET VANE 1 TO 23.12 DEGREES SET VANE 2 TO 7.59 DEGREES SET VANE 3 TO 8.82 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD REMC COMSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF __CORRECTED FLOW= 83.4800 SURGE MARGIN= 10.0300

EFFICIENCY= 86.9200

PRECISE FUNCTION VALUES 0.83480E+00 0.10030E+00 0.86920E+02
BEGIN ITERATION NUMBER 7
NOMINAL DESIGN NUMBER = 11
X-VECTCR 0.23116E+02 0.75931E+01 0.88209E+01 0.50000E+01
FUNCTION VALUES 0.85400E+02 0.10030E+02 0.86920E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.24352E+01 0.21607E+01 -0.30000E+01 0.0
X-VECTOR 0.20631E+02_0.97537E+01_0.58209E+01_0.50000E+01_
AFFROXIMATE FUNCTION VALUES 0.84724E+02 0.98653E+01 0.86752E+02
SET VAME 1 TO 20.63 DEGREES
SET VAN 2 TO 9.75 DEGREES
SET VAME 3 TO 5.82 DEGREES
SET VARE 4 TO 5.00 DECREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD CL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 84.3100
SURGE MARGIN= 10.0500
EFFICIENCY= 86.8000
PRECISE FUNCTION VALUES0.84310E+02
BEGIN ITERATION NUMBER 8
NOMINAL DESIGN NUMBER = 12
X-VECTOR 0.20631E+02 0.97537E+01 0.58209E+01 0.50000E+01
FUNCTION VALUES 0.84310E+02 0.10050E+02 0.86800E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTC? 0.35567E+00 0.21365E+00 -0.82088E+00 0.53036E-07
X-VECTOR 0.207656+02 0.99674E+01 0.50000E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES
0.04331E+02 0.10389E+02 0.86806E+02

SET VANE 2 TO 9.97 DEGREES SET V: 3 TO 5.00 DEGREES SET V: 3 TO 5.00 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD RPHC CONSTANT AT A VALUE OF 76.779 CCRECTED FLCN= (3100 SURGE MARGIN= 10.1400 EFFICIENCY= 86.7800 MNHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH	SET VANE 1 TO 20.99 DEGREES
SET VANE 4 TO 5.00 DEGREES HOLD RPHC CONSTANT AT A VALUE OF 76.779 CCRRECTED FLOW= (3100 SURGE MARGIN= 10.1400 EFFICIENCY= 86.7800 MNHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH	SET VANE 2 TO 9.97 DEGREES
HOLD RPNC CONSTANT AT A VALUE OF 76.779 HOLD OL CONSTANT AT A VALUE OF 76.779 CCRRECTED FLONE (3100 SURGE MARGINE 10.1400 EFFICIENCY= 86.7800 **********************************	SET V. 3 TO 5.00 DEGREES
HOLD OL CONSTANT AT A VALUE OF 76.779 CCRRECTED FLONE (3100 SURGE MARGINE 10.1400 EFFICIENCY= 86.7800 ##################################	SET VANE 4 TO 5.00 DEGREES
HOLD OL CONSTANT AT A VALUE OF 76.779 CCRRECTED FLONE (3100 SURGE MARGINE 10.1400 EFFICIENCY= 86.7800 ##################################	HOLD RPMC CONSTANT AT A VALUE OF 5567.500
SURGE MARGIN= 10.1400 EFFICIENCY= 86.7800 **********************************	HOLD OL CONSTANT AT A VALUE OF 76.779
######################################	CCRRECTED FLOR= 64 3100
PRECISE FUNCTION VALUES 0.64310E+02 0.1014GE+02 0.86780E+02 BEGIN ITERATION NUMBER 9 NOMINAL DESIGN NUMBER = 13 X-VECTOR 0.09956E+02 0.99674E+01 0.50000E+01 0.50000E+01 FUNCTION VALUES 0.24320E+02 0.10140E+02 0.86780E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.20051E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64346E+02 0.98981E+01 0.86785E+02 WHENE WHE	SURGE MARGIN= 10.1400
PRECISE FUNCTION VALUES 0.64310E+02 0.10140E+02 0.86780E+02 BEGIN ITERATION NUMBER 9 NOMINAL DESIGN NUMBER = 13 X-VECTOR 0.60906E+02 0.99674E+01 0.50000E+01 0.50000E+01 FUNCTION VALUES 0.84320E+02 0.10140E+02 0.86780E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.6001E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 WHARREWELLERHERHERHERHERHERHERHERHERHERHERHERHERHE	EFFICIENCY= 86.7800
PRECISE FUNCTION VALUES 0.64310E+02 0.10140E+02 0.86780E+02 BEGIN ITERATION NUMBER 9 NOMINAL DESIGN NUMBER = 13 X-VECTOR 0.09936E+02 0.99674E+01 0.50000E+01 0.50000E+01 FUNCTION VALUES 0.84320E+02 0.10140E+02 0.86780E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.00051E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 MHRHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH	销售货汽车货产工业货产货货货货货货货货货货货货货货货货货货货货
DEGIN ITERATION NUMBER 9	
DEGIN ITERATION NUMBER 9	
BEGIN ITERATION NUMBER 9	PRECISE FUNCTION VALUES
NOMINAL DESIGN NUMBER = 13	0.64310E+02 0.10140E+02 0.86780E+02
NOMINAL DESIGN NUMBER = 13	
NOMINAL DESIGN NUMBER = 13	BEGIN ITERATION NUMBER 9
X-VECTOR	
0.0936E+02 0.99674E+01 0.50000E+01 0.50000E+01 FUNCTION VALUES 0.24320E+02 0.10140E+02 0.86780E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.90349E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.2030E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 ###################################	NOMINAL DESIGN NUMBER = 13
0.0936E+02 0.99674E+01 0.50000E+01 0.50000E+01 FUNCTION VALUES 0.24320E+02 0.10140E+02 0.86780E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR -0.90349E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.2030E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 ###################################	
FUNCTION VALUES	
######################################	0.235362402 0.796742401 0.500002401 0.500002401
######################################	FUNCTION VALUES
DELTA-X VECTOR -0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.20001E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 ###################################	0.84310E+02 0.10140E+02 0.86780E+02
DELTA-X VECTOR -0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.20001E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 ###################################	
-0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05 X-VECTOR 0.20001E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.86785E+02 ###################################	RESULTS OF APPROXIMATE OPTIMIZATION
X-VECTOR	DELTA-X VECTOR
0.20081E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.85785E+02 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	-0.90549E+00 0.34120E+00 0.85419E+00 0.12793E-05
0.20081E+02 0.10309E+02 0.58542E+01 0.50000E+01 APPROXIMATE FUNCTION VALUES 0.64344E+02 0.98981E+01 0.85785E+02 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	X-VECTCR
0.64344E+02 0.98981E+01 0.86785E+02 ###################################	
0.64344E+02 0.98981E+01 0.86785E+02 ###################################	APPROXICATE FUNCTION VALUES
SET VANE 1 TO 20.08 DECREES SET VANE 2 TO 10.31 DEGREES SET VANE 3 TO 5.85 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD DESIGN AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOWS 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	
SET VANE 2 TO 10.31 DEGREES SET VANE 3 TO 5.85 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD DIMC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOWS 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	******
SET VANE 2 TO 10.31 DEGREES SET VANE 3 TO 5.85 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD DIMC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOWS 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	
SET VANE 3 TO 5.65 DEGREES SET VANE 4 TO 5.00 DEGREES HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOWS 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	SET VAME 1 TO 20.08 DECREES
SET VAME 4 TO 5.00 DEGREES HOLD DEFINE CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	SET VANE 2 TO 10.31 DEGREES
SET VAME 4 TO 5.00 DEGREES HOLD DEFINE CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	SET VANE 3 TO 5.65 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD CL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	
HOLD CL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100 WWW.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.	
HOLD CL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 84.3900 SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100 WWW.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.	HOLD REMC COMSTANT AT A VALUE OF 5567.500
SURGE MARGIN= 10.1900 EFFICIENCY= 86.8100	
EFFICIENCY≈ 86.8100	
МАННЕН ВЕЗГРИНИ ВЕЗГРИНИ ВЕЗГРИНИ ВЕЗГРИНИ ВЕЗГРИНИ ВЕЗГРИНИ	SURGE MARGIN= 10.1900
	EFFICIENCY= 86.8100
	福沙斯拉特斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯
PRECISE FUNCTION VALUES	PRECISE FUNCTION VALUES

ICMINAL DESIGN NUMBER = 14	
(-VECTOR	·
0.20031E+02 0.10309E+02 0.58542E+01	0.50000E+01
UNCTION VALUES 0.84390E+02 0.10190E+02 0.86810E+02	و سندر ومساوره
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZ	HOITA
TITLE *****************************	*****
GLOBAL LOCATIONS OF X-VARIABLES 1 2 3 4	
GLOBAL LOCATIONS OF FUNCTIONS, F(X) 8 6 7	
APPROXIMATION IS BASED ON 14 DESIGNS	
NOMINAL DESIGN IS DESIGN NUMBER 14	•
VALUES OF X-VARIABLES 0.2008E+02 0.1031E+02 0.5854E+01	0.5000E+01
VALUES OF FUNCTIONS, F(X) 0.8439E+02 0.1019E+02 0.8681E+02	
COEFFICIENTS OF TAYLOR SERIES EXPANSION	
PARAMETER 1 = GLOBAL VARIABLE 8	
LINEAR TEPMS, DEL F 0.2423E+000.1381E+000.1230E+00	0.1432E+00
NON-LINEAR TERMS, H, BEGINING WITH DIAGO	DNAL ELEMENT
90'A 1 -0.2491E-01	
ROH 2 -0.7463E-02	
ROW 3 -0.1002E-01	· · · · · · · · · · · · · · · · · · ·
ROH 4 -0.1176E-02	
PARAMETER 2 = GLOBAL VARIABLE 6	
LINEAR TERMS, DEL F -0.2136E-01 0.1367E-01 0.1433E-01	-0.9647E-02

ROW -0.22	1 48E-01				
ROJ -0.57	2 67E-02				
RON	3 13E-01				
ROม 	4 17E-01				
PARAMET	ER 3 = (SLOBAL VAR	IABLE 7		
	TERNS, DEL 52E-01 0	F	0.7303E-01	0.2221E-01	-
NON-LIN	EAR TERMS,	H, BEGINI	NG WITH DIAGON	AL ELEMENT	-
RCH -0.21					_
RON -0.46	2 65E-02				
ROW -0.12	3 03E-01				_
RON -0.95	4 92E-02				
OPTIMIZ	ATION RESUL	.TS			
GLOBAL		8 FU	NCTION VALUE 0	.84390E+02	
DESIGN	VARIABLES .				
IO	D. V.	GLOBAL VAR. NO.	LOWER BOUND	VALUE	UPPER BCUND
1	1	1	0.10000E+02 0.50000E+01	0.20081E+02	0.35000E+02_
2	2	2	0.500002+01	0.10309E+02	0.25000E+02
3 4	3 4	2 3 4	0.500002+01	0.58542E+01 0.50000E+01	0.25000E+02 0.25000E+02
DESIGN	CONSTRAINTS	3	-		
	GLCBAL	LC':E	R	UPPEI	· —
10	VAR. NO.	EQU	:10 VALI	UE ECU	לי)
1	6	0.85000	E+01 0.10190	E+02 0.10000	R ND E+03 E+04
4884448	++ Final S	OLUTION V	ALUES ******		
			20.08 DE		
VANE AN	GLE FOR VAN	E 2 I3 -	10.31 DE	GREES	
			5.85 DE		
" VANE 75	JLE FOR VAL	E 4 15	5.00 DE	GREES	·

STATOR VANE OPTIMIZER

_PROTOTYPE_SOFTWARE_CAPABLE_OF_GUIDING_THE_OPTIMIZATION_OF___

STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR

PREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY

UNDER CONTRACT F33615-79-C-2013

BY: FRATT & WHITNEY AIRCRAFT GROUP GOVERNMENT FOODUCTS DIVISION

PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU

NO.	I	GOAL						TICNS O.L.	_				_
1	I	EFF	ī	X	-	_	_ X_	-	I		I		I
2	Ĩ	EFF	ī	~ x —	-	"		X	I	-	I	-	I
3	I	EFF	I	-	X	X	-	-	I	-	I	-	I
4	I	EFF	I	X	-	-	X	-	I	MIN	I	-	I
5	I	EFF	1	X	- -			X	I	MIN_	I		I
6	I	EFF	I	-	X	X	-	-	I	MIN	I	-	I
7	I	s.M.	I	X	-	-	X	-	I	-	I	-	I
8	I	S.M.	I	X	-	-	-	X	I	-	I	-	I
9	I	_ S.M	Į		_X_	_X_			Į	_=_	Ţ		.I
10	Ι	S.M.	I	X	-	-	×	-	I	-	I	MIN	I
11	1	S.M.	I	X	-	-	-	X	I	-	I	MIN	I
12	I	S.M.	I	-	X	X	-	-	I	-	I	MIN	I
13	_I	_SM/BLD	I	X	×_				I		_I	-	I
14	I	MAX NO	I	X	•	-	-	Х	I	MIN	1	MIN	I
15	I	MIN MC	I	X	-	-	-	X		MIN		MIH	I
16	I	£'S	I	X	X	-	-	-	_	MIN		MIN	I
17	I	FR	I	. X		-	-	X	I	MIN_	I	MIN	
YC	U	HAVE SE	E	CTED 1	O MI	NIM	IZE CO	RRECTE	ED	FLOW	Н	DLDING	;

CORRECTED SPEED (RPMC) AND OPERATING LINE (OL) CONSTANT

WHILE CONSTRAINING SURGE MARGIN AND EFFICIENCY TO MINIMUM VALUES HOLD REMC CONSTANT AT 5567.500 HOLD OL CONSTANT AT 76.779 OPTIMIZING 4 VANE ANGLE(S) LOHER BOUND FOR VANE 1 IS 10.000 DO YOU ACREE? (Y/N) LOWER BOUND FOR VANE 2 IS 5.000 CO YOU AGREE? (Y/N) LOHER BOUND FOR VANE 3 IS 5.000 DO YOU AGREE? (Y/N) LOHER BOUND FOR VANE 4 IS 5.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 1 IS 35.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 2 IS 25.000 DO YOU AGREE? (Y/N) UPPER BOUND FOR VANE 3 IS 25.000

DO YOU ACREE? (Y/N)

UPPER BOUND FOR VANE 3 IS 25.000

DO YOU ACREE? (Y/N)

LONER BOUND VALUE FOR SN IS 8.500

UPPER BOUND VALUE FOR SM IS 100.000

LONER BOUND VALUE FOR EFF IS 87.000

UPPER BOUND VALUE FOR EFF IS 1000.000

INCREMENTAL VAME ANGLE VALUE FOR INITIAL VANE SETTING IS -2.00

CONTROL	PARAMET	rers;						
CALCUL	TION CON	NTROL,		NCALC	=	6		
NUIBER	OF GLCB!	AL DESIGN	VARIABLES	NDV	_=	_4_		
			ARIABLES,			0		
			TWO-SPACE			0 4		
THEUT 1	NFORMAT	ON PRINT	VAR.	IPNPLIT	=	ĭ		
DEBUG	RINT CO	DE,		IPDBG	=			•
CALCIUA	TTON CO	STENI. NO	ALC					
	MEANING							
1		ANALYSIS						
	OPTIMI							
3	_SENSIT:	IVITY		· <u>-</u>				
4	TUG-VAR	RIABLE FU	NCTION SPA	CE				
5	OPTIMU	7 SENSITI	NCTION SPA VITY IMIZATION					
6	APPROX.	ENATE OF	INIZATION					
	LIER (NEC	GATIVE IN	OF OBJECTI DICATES MI ERO. CONMI	NIMIZAT	ICN)		.1000E	
COMIN	PÄRÄMETI	GATIVE IN ERS (IF Z	DICATES MI	INIMIZAT IN DEFAU	ICN) LŤ W	e- = ILL 0	.1000E VER-RI	DE)
COMMIN IFRINT 5	PARAMETI ITMAX 20	GATIVE IN ERS (IF Z ICNDIR 5	DICATES MI ERO, CONMI NSCAL 0	NIMIZAT IN DEFÄU ITRM 3	ICN) LT W LIND	6- = О 111 И СЕ	.1000E VER-RII IACMX1 10	NFDI
COUMIN IFRINT 5 FOCH 0.1000	PARAMETI ITHAX 20 00E-01	GATIVE IN ERS (IF Z ICNDIR 5 FDCHM 0.1000	DICATES MI ERO, COMMI NSCAL 0	NIMIZAT IN DEFAU ITRM 3 CT -0.50000	ICN) LT W LIND 0 E-01	0- = О ЛЛ О	VER-RIMACMX1 10 CTMIN 0.4000	NFDI
COUMIN IFRINT 5 FDCH 0.1000	PARAMETI ITMAX 20 00E-01	GATIVE IN ERS (IF Z ICNDIR 5 FOCHM 0.1000	DICATES MI ERO, CONMI NSCAL 0	INIMIZAT IN DEFAU ITRM 3 CT -0.50000	ICN) LT W LINO 0 E-01	= -0 ILE 0	VER-RI	NFDI
COUMIN IFRINT 5 FDCH 0.1000	PARAMETI ITMAX 20 00E-01	GATIVE IN ERS (IF Z ICNDIR 5 FOCHM 0.1000	DICATES MI ERO, COMMI NSCAL 0	INIMIZAT IN DEFAU ITRM 3 CT -0.50000	ICN) LT W LINO 0 E-01	= -0 ILE 0	VER-RIMACMX1 10 CTMIN 0.4000	NFDI
COMMIN IFRINT 5 FOCH 0.1000	PARAMETI ITMAX 20 00E-01	GATIVE IN ERS (IF Z ICNDIR 5 FOCHM 0.1000 CTLMIN 0.1000	DICATES MI ERO, CONMI NSCAL 0 0E-02	NIMIZAT IN DEFAU ITRM 3 CT -0.50000 THETA 0.10000	ICN) LT W LIND 0 E-01 E+01	е- = 0 ЛЛ и се	VER-RII ACMX1 10 CTMIN 0.4000	NFDI O
COMMIN IFRINT 5 FOCH 0.1000	PARAMETI ITMAX 20 00E-01	GATIVE IN ERS (IF Z ICNDIR 5 FOCHM 0.1000 CTLMIN 0.1000	DICATES MI ERO, CONMI NSCAL 0 0E-02	NIMIZAT IN DEFAU ITRM 3 CT -0.50000 THETA 0.10000	ICN) LT W LIND 0 E-01 E+01	е- = 0 ЛЛ и се	.1000E VER-RII ACMX1 10 CTMIN 0.4000 PHI 0.0 ABOBJ1	NFDI O
COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000 DESIGN	PARAMETI ITMAX 20 00E-01 00E-01 VARIABLI	GATIVE IN ERS (IF Z ICNDIR 5 FOCHM 0.1000 CTLMIN 0.1000 DABFUN 0.0	NSCAL 0 0 0E-02	ITRM 3 CT -0.50000 THETA 0.10000 ALPHAX 0.10000	ICN) LT W LIND E-01 E+01	= -0	.1000E .VER-RIO .ACMX1 10 .CTMIN 0.4000 PHI 0.0 ABOBJ1 0.10000	NFDI O
FDCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZER	PARAMETI ITMAX 20 00E-01 O0E-01 VARIABLI RO INITI	FOCHIO O.1000 CTLNIN O.1000 CTLNIN O.1000 DABFUN O.0	DICATES MI ERO, CONMI NSCAL 0 0E-02 0E-02 TION WILL OVER-	ITRM 3 CT -0.50000 THETA 0.10000 ALFHAX 0.10000	ICN) LT W LIND E-01 E+01 E+00	E - 0	.1000E VER-RI ACMX1 10 CTMIN 0.4000 PHI 0.10000	NFDI O
FOCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZER 0. V.	PARAMETI ITMAX 20 COE-O1 OOE-O2 VARIABLE ROUNTI	FOCHM O.1000 CTLMIN O.1000 DABFUN O.0 E INFORMA AL VALUE	NSCAL 0 0E-02 TION WILL OVER- UPPER	ITRM 3 CT -0.50000 THETA 0.10000 ALFHAX 0.10000	LT W LIND 0 E-01 E+01 E+00	6- = 0 ЛЛ И СЕ	.1000E VER-RI ACMX1 10 CTMIN 0.40000 PHI 0.0 ABGBJ1 0.10000	NFDI O ODE-02
FOCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZER 0. V.	PARAMETI ITMAX 20 COE-O1 OOE-O2 VARIABLE ROUNTI	FOCHM O.1000 CTLMIN O.1000 DABFUN O.0 E INFORMA AL VALUE	NSCAL 0 0E-02 TION WILL OVER- UPPER	ITRM 3 CT -0.50000 THETA 0.10000 ALFHAX 0.10000	LT W LIND 0 E-01 E+01 E+00	6- = 0 ЛЛ И СЕ	.1000E VER-RI ACMX1 10 CTMIN 0.40000 PHI 0.0 ABGBJ1 0.10000	NFDI O ODE-02
FOCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZER 0. V.	PARAMETI ITMAX 20 COE-O1 OOE-O2 VARIABLE ROUNTI	FOCHM 0.1000 CTLMIN 0.1000 DABFUN 0.0	NSCAL 0 0E-02 TION WILL OVER- UPPER	ITRM 3 CT -0.50000 THETA 0.10000 ALFHAX 0.10000	LT W LIND 0 E-01 E+01 E+00	6- = 0 ЛЛ И СЕ	.1000E VER-RI ACMX1 10 CTMIN 0.40000 PHI 0.0 ABGBJ1 0.10000	NFDI O ODE-02
COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZEF D. V.	PARAMETI ITMAX 20 COE-O1 OOE-O2 VARIABLE ROUNTI	FOCHM 0.1000 CTLMIN 0.1000 DABFUN 0.0	NSCAL 0 0E-02 TION WILL OVER- UPPER	ITRM 3 CT -0.50000 THETA 0.10000 ALFHAX 0.10000	LT W LIND 0 E-01 E+01 E+00	6- = 0 ЛЛ И СЕ	.1000E VER-RI ACMX1 10 CTMIN 0.40000 PHI 0.0 ABGBJ1 0.10000	NFDI O ODE-02
COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZEF D. V.	PARAMETI ITMAX 20 COE-O1 OOE-O2 VARIABLE ROUNTI	FOCHM O.1000 CTLMIN O.1000 CTLMIN O.1000 DABFUN O.0 E INFORMA AL VALUE R ODE+02 DE+01 DE+01	DICATES MI ERO, CONMI NSCAL 0 0E-02 0E-02 TION WILL OVER-	THETA 0.10000 ALPHAX 0.10000 PRIDE MO I 0.0000 CRIDE MO I 0.0000 C	ICN) LT W LINDO 0 E-01 E+01 E+01 DULE NITLU 2700:1600 1300	6- = 0 ЛЛ И СЕ	.1000E VER-RI ACMX1 10 CTMIN 0.4000 PHI 0.0 ABGBJ1 0.10000 T	NFDO O ODE-02
COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000 DESIGN NON-ZER 0. V. HO. 1 2 3 4	PARAMETI 17ffAX 20 20E-01 00E-01 VARIABLE RO INITIL LOUIS 0.1000 0.50000 0.50000	FOCHM 0.1000 CTLMIN 0.1000 DABFUN 0.0 E INFORMA AL VALUE 20 DE+01 DE+01 DE+01 DE+01	DICATES MI ERO, CONMI NSCAL 0 0E-02 DE-02 TION WILL OVER- UPPER BSUND 0.35000E+0 0.25000E+0	THETA 0.10000 ALPHAX 0.10000 PRIDE MO I 0.0000 CRIDE MO I 0.0000 C	ICN) LT W LINDO 0 E-01 E+01 E+01 DULE NITLU 2700:1600 1300	= -0 ILL 0 BJ N INPU AL EDE+02 DE+02 DE+02	.1000E VER-RI ACMX1 10 CTMIN 0.4000 PHI 0.0 ABGBJ1 0.10000 T	NFD 0 0 0E-02 0E+00
COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZEF 0. V. NO. 1 2 3 4	PARAMETI ITMAX 20 00E-01 VARIABLE 0.1000 0.50000 0.50000 VARIABLE	FOCHM O.1000 CTLMIN O.1000 CTLMIN O.1000 DABFUN O.0 E INFORMA AL VALUE R ODE+01 DE+01 DE+01	DICATES MI ERO, CONMI NSCAL 0 0E-02 0E-02 TION WILL OVER- UPPER BOUND 0.35000E+0 0.25000E+0	THETA 0.10000 ALFHAX 0.10000 PRIDE MO I 0.000 0.	ICN) LT W LINDO 0 E-01 E+01 E+01 DULE NITLU 2700:1600 1300	= -0 ILL 0 BJ N INPU AL EDE+02 DE+02 DE+02	.1000E VER-RI ACMX1 10 CTMIN 0.4000 PHI 0.0 ABGBJ1 0.10000 T	NFDO O OE-02 OE+00
COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUS 0.1000 DESIGN NON-ZEF 0. V. NO. 1 2 3 4	PARAMETI ITMAX 20 00E-01 VARIABLE 0.1000 0.5000 0.5000 VARIABLE 0. V.	FOCHM O.1000 CTLMIN O.1000 CTLMIN O.1000 DABFUN O.0 E INFORMA AL VALUE R ODE+01 DE+01 DE+01	DICATES MI ERO, CONMI NSCAL 0 0E-02 0E-02 TION WILL OVER- UPPER BOUND 0.35000E+0 0.25000E+0 0.25000E+0	ITRM 3 CT -0.50000 THETA 0.10000 ALFHAX 0.10000 -RIDE MO I 0.2 0.02 0.02 0.02 0.0000	ICN) LT W LINDO 0 E-01 E+01 E+01 DULE NITLU 2700:1600 1300	= -0 ILL 0 BJ N INPU AL EDE+02 DE+02 DE+02	.1000E VER-RI ACMX1 10 CTMIN 0.4000 PHI 0.0 ABGBJ1 0.10000 T	NFDO O ODE-02

3 4	3	3		0000E+01 0000E+01				
COHS	TRAINT IN	SECTAMENT O	N					
THED	F ADE 2	CONSTRAI	NT CFTC					
10	GLOBAL	GLOBAL VAR. 2		LOKER BOUND		NORMALIZATION FACTOR	UPPER BOUND	NORMALIZATION FACTOR
1	6	6	0	0.850001				
3_	7	7	0	0.87000	E+02_	0.87000E+02		
ATOTA	L KUKBER	OF CONST	RAINED P	ARAMETERS :	•	2		
* * .	APPROXIM/	TE ANALY	SIS/OPTI	MIZATION IN	KFORM	ATION		
NUMB	ER OF FUN	CTIONS A	PFROXIMA	TED, NF =	0			
NU. IE	ER OF INS	UT X-VEC	TCRS,	NPS =	5	·		
		UT X-F P		NPFS =	Ð			
		1 ANALIZ,		NPA =	-			
	NAL DESIG	X-VECTO	ne	INCM = ISCRX =	0			
READ	UNIT FOR	X-F PAI		ISCRXF =	5			
	T CONTROL		,	IPAPRX =	ĩ			
								
				KMIN =	.5			
				KMAX = NPMAX =	17 28			
		N PARAME		= MONL				
		PUT PARALL			6-			
F-LO	CATION IN	CUT PARA	METER.	INFLOC =	Ď			
		I.D. CC		MAXTRM =	2			
			0.200	E OPTIMIZAT 0E+01 0.20	00E+			
	IPLIER C			XFACT1 =	Ö.15	00E+01		
MULT	IPLIER ON	DELX,		YFACT2 =	0.20	00E+01		
	AL LOCATI 1 2	ONS CE X	-Variābū	ES				
	AL LOCATI 8 6	OKS OF F	UNCTIONS					
X-VE	CTORS IN	'ÚT"FROM` (UNIT !	5				
121117 10.29		DESIG .1800E+0		DE+02 -0.11	.00E+	02		
MUIBI	ER 2	DESIG	N 2					

	0.2700E+02	0.1800E+02	0.15008	E+02	0.1100E+02	
	NUMBER3	DESIGN	3			
	0.2700E+02	0.1600E+02	0.15008	E+02	0.1100E+02	
	NUMBER 4	DESIGN	4			
	0.2700E+02	0.1600E+02	0.1300	E+02	0.1100E+02	
	MUMBER 5	DESTAN	ĸ			
	0.27G0E+02	DESIGN 0.1600E+02	0.1300	+02	0.9000E+01	
	* * ESTIMAT	ED DATA STOR	AGE REGU	JIREMEI		
	R	EAL			INTEGER	
	INFUT EXEC	UTION AVALI	ABLE	INFU	TEXECUTION	AVAILABLE
*×		********		30	78	1000
	SET VARE 1	TO 29.00 E	EGREES			
		TC 18.00 C				
		TO 15.00 C				
		TO11.00_0				
	HOLD RPMC C	CHSTANT AT A	VALUE O)F }F	5567.500 76.779	
	CGRRECTED F	LCW= 77.5300				
	SURGE MARGI	N= 8.3600)			
	EFFICIENCY=	87.1800		·		
**	******	*****	*****	•		
, ::		******		<u></u> -		
**	*************	n n n n n n n n n n n n n n n n n n n	· 法共享货币 计	•		
	SET VANE 1	TO 27.00 D	EGREES_			
	SET VANE 2	TO 18.00 C	EGREES			
	SET VANE 3	TO 15.00 C	EGREES			
		TO 11.00 C				·
	HOLD RFMC C	ONSTANT AT A	VALUE C)F	5567.500	
	HOLD OF C	CHSTANT AT A	VALUE C)F	76.779	
	SURGE MARGI	N= 8.8300	,			

EFFICIENCY= 87.3100 **************** ********* SET VANE 1 TO 27.00 DEGREES SET VANE 2 TO 16.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD RPMC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF CORRECTED FLOW= 78.7800 SURGE MARGIN= 8.8300 EFFICIENCY= 87.2500 ******** ********** SET VANE 1 TO 27.00 DEGREES SET VARIE 2 TO 16.00 DEGREES SET VANE 3 TO 13.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD RENC CONSTANT AT A VALUE OF 5567.500
FULD OL CCHSTANT AT A VALUE OF 76.779 CCRRECTED FLOH= 79.1900 SURGE MARGIN= 8.9700 EFFICIENCY= 87.3000 ************** *************** SET VANE 1 TO 27.00 DEGREES SET VANE 2 TO 16.00 DEGREES SET VANE 3 TO 13.00 DEGREES SET VANE 4 TO 9.00 DEGREES 5567.500 HOLD RPMC CONSTANT AT A VALUE OF HOLD OL CONSTANT AT A VALUE OF CCRRECTED FLOH= 79.4900 SURGE MARGIN= 9.2100 EFFICIENCY= 87.3300

APPROXIMATING FUNCTIO	NS ASSOCIATED WITH CONSTRAINTS
DESIGN VARIABLE NUMBE 1 2 3 4	RS ASSOCIATED WITH APPROXIMATING VARIABLE
BEGIN ITERATION NUMBE	R 1
NOMINAL DESIGN NUMBER	=_2
	0E+02 0.15000E+02 0.11000E+02
FUNCTION VALUES 0.78420E+02 0.8830	0E+01 0.87310E+02
RESULTS OF APPROXIMAT	E ÖPTİNIZATION
DELTA-X VECTOR 0.48537E+000.2000	0E+010.20000E+010.20000E+01
X-VECTCR 0.26515E+02 0.2000	0E+02 0.17000E+02 0.13000E+02
ÄPPROXIMÄTE FUNCTION 0.77566E+02 0.8564 ####################################	1E+01 0.87322E+02
SET VANE 1 TO 26.51	DEGREES
SET VANE 2 TO 20.00	DEGREES
SET VANE 3 TO 17.00	DEGREES
SET VANE 4 TO 13.00	DEGREES
HOLD REMC CONSTANT AT HOLD OL CONSTANT AT CORRECTED FLOWS 77.25	A VALUE OF 5567.500 A VALUE OF 76.779 00
SURGE MARGIN= 8.21	00
EFFICIENCY= 86.94	00
*********************	经验证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证证

BEGIN ITERATION NUMBER OF STREET	
	DER - G
X-VECTOR 0.26515E+020.2	20000E+02 <u>0</u> .17000E+02 <u>0</u> .13000E+0
FUNCTION VALUES	
0.77250E+02 0.8	82100E+01 0.86940E+02
RESULTS OF APPROXI	IMATE OPTIMIZATION
DELTA-X VECTOR	
0.17665E+01 0.2	20000E+01 0.20000E+01 -0.18405E+0
X-VECTOR	
_ 0.28281 E+0 2_ 0.2	22000E+02 <u>_0.19</u> 000E+02 <u>_0.</u> 11159E+0
AFFROXINATE FUNCTI	
0.76527E+02 0.8	95000E+01 0.87535E+02
SET VANE 1 TO 28	3.28 DEGREES
SET VARE 2 TO 22	2.00 DEGREES
SET VANE 3 TO 19	.00 DEGREES
SET VARE 4 TO 11	1.16 DEGREES
HOLD RENC CONSTANT	F AT A VALUE OF 5567.500
HOLD OL CONSTANT	T AT A VALUE OF 76.779
CORRECTED FLOH= 75	3.8800
SURGE MARGIN= 7	7.5700
EFFICIENCY= 86	6700
**********	· · · · · · · · · · · · · · · · · · ·
PRECISE FUNCTION V	/ALLIEC
	75700E+01 0.86670E+02
BEGIN ITERATION NU	MBER 3
NOMINAL DESIGN NUM	1BER = 7
X-VECTOR	
	22000E+02 0.19000E+02 0.11159E+0
FUNCTION VALUES	
0.75830E+02 0.7	75700E+01 0.86670E+02

ALLOSTO GI ALLOSTONICO GI VALIZZANIZZANI	
DELTA-X VECTOR	
-0.83365E+00 -0.29508E+01 0.20000E+01 -0.20000	E+01
X-VECTOR	
0.27447E+02 0.19049E+02 0.21000E+02 0.91595	E+01
APPROXIMATE FUNCTION VALUES	
0.77092E+02_0.84882E+01_0.87185E+02	
· · · · · · · · · · · · · · · · · · ·	
SET VANE 1 TO 27.45 DEGREES	
SET VANE 2 TO 19.05 DEGREES	
SET VANE 3 TO21.00 DEGREES	
SET VANE 4 TO 9.16 DEGREES	
HOLD REMC CONSTANT AT A VALUE OF 5567.500_	
HOLD OL CONSTANT AT A VALUE OF 76.779	
CORRECTED FLOW= 76.2900	
SURGE MARGIN= 7.5500	
EFFICIENCY= 86.1500	
· 产业的的证据,我就就被除款的证据的证据的证据的证据的证据的证据的证据的证据的证据的证据的证据的证据的证据的	
FRECISE FUNCTION VALUES	
0.76290E+02 0.75500E+01 0.86150E+02	
BEGIN ITERATION NUMBER 4	
DEGIN TERRITON NOIDER 4	
NOMINAL DESIGN NUMBER = 8	
X-VECTOR	
0.27447E+02 0.19049E+02 0.21000E+02 0.91595	E+01
FUNCTION VALUES	
0.76290E+02 0.75500E+01 0.86150E+02	
RESULTS OF APPROXIMATE OPTIMIZATION	
DELTA-X VECTOR 0.31427E-01 0.30000E+01 -0.30000E+01 -0.20000	E+01
X-VECTUR 0.27479E+02 0.22049E+02 0.18000E+02 0.71595	
0.2/4/7L402 0.22047L402 0.10000E402 0./15431	. + u 1
APPROXIMATE FUNCTION VALUES	

0.77170E+02 0.84750E+01 0.86989E+02

	SET VANS 1 TO 27.48 DEGREES
	SET VANE 2 TO 22.05 DEGREES
	SET VARE 3 TO 18.00 DEGREES
	SET VANE 4 TO 7.16 DEGREES
	HOLD RENC CONSTANT AT A VALUE OF 5567.500
	HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOW= 76.8800
	SURGE MARGIN= 8.0200
	EFFICIENCY= 86.8000

	PRECISE FUNCTION VALUES 0.76880E+02

	BEGIN ITERATION NUMBER 5
	PCMINAL DESIGN NUMBER = 9
	X-VECTOR
	0.274792+02 0.22049E+02 0.18000E+02 0.71595E+01
	FUNCTION VALUES
	0.76880E+02 0.80200E+01 0.86800E+02
	RESULTS OF AFFROXIMATE OPTIMIZATION
	DELTA-X VECTOR
_	-0.63346E+00 0.29503E+01 0.12337E+01 0.30000E+01
	X-VECTOR
	0.26840E+02 0.25000E+02 0.19234E+02 0.10159E+02
-	APPROXIMATE FUNCTION VALUES
	0.76410E+02
	· · · · · · · · · · · · · · · · · · ·
	SET VANE 1 TO 26.84 DEGREES
_	SET VANE 2 TO 25.00 DEGREES
	SET VANE 3 TO 19.23 DEGREES
	SET VANE 4 TO 10.16 DEGREES

HOLD OL CONSTANT AT A VALUE OF 76.779 COMPRECTED FLOW= 75.1800
SURGE MARGIN= 7.0000
EFFICIENCY= 86.1100

PRECISE FUNCTION VALUES 0.75180E+02 0.70000E+01 0.86110E+02
BEGIN ITERATION NUMBER 6
NOMINAL DESIGN NUMBER = 10
X-VECTOR 0.26840E+020.25000E+020.19234E+020.10159E+02
FUNCTION VALUES 0.75180E+02 0.70000E+01 0.86110E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.81091E+00 -0.30000E+01 -0.30000E+01 -0.14534E+01
X-VECTOR 0.27651E+02 0.22000E+02 0.16234E+02 0.87060E+01
APPROXIMATE FUNCTION VALUES 0.772445+02 0.835055+01 0.87146E+02
SET VANE 1 TO 27.65 DESREES
SET VANE 2 TO 22.00 DEGREES
SET VANE 3 TO 16.23 DEGREES
SET VANE 4 TO 8.71 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOR= 77.1800
SURGE MARGIN= 8.2300
EFFICIENCY= 87.0700

FRECISE FUNCTION VALUES0.77180E+02
DEGIN ITERATION NUMBER 7
NOMINAL DESIGN NUMBER = 11
X-VECTOR 0.27651E+02 0.22000E+02 0.16234E+02 0.87060E+01
FUNCTION VALUES 0.771808+02 0.80300E+01 0.87070E+02

RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.61297E-01 -0.86176E+00 -0.83577E+00 -0.12166E+00
X-VECTOR 0.27599E+02 0.21138E+02 0.15398E+02 0.85843E+01
APPROXIMATE FUNCTION VALUES 0.77682E+02 0.84913E+01 0.87205E+02
SET_VANE_1_TO 27.59 DEGREES
SET VANE 2 TO 21.14 DEGREES
SET_VANE 3 TO 15.40 DEGREES
SET VANE 4 TO 8.58 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLORE 77.6800
SURGE MARGIN= 8.4500
EFFICIENCY= 87.2200

PRECISE FUNCTION VALUES 0.77680E+02 0.84500E+01 0.87220E+02 BEGIN ITERATION NUMBER 8
NOMINAL DESIGN NUMBER = 12
X-VECTOR 0.27539E+02 0.21138E+02 0.15398E+02 0.85043E+01
FUNCTION VALUES 0.77600E+02 0.84500E+01 0.87220E+02
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR 0.24845E+00 -0.36500E+00 -0.20615E+00 -0.47718E-01
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR 0.24845E+00 -0.36500E+00 -0.20615E+00 -0.47718E-01 X-VECTOR 0.27338E+02 0.20773E+02 0.15192E+02 0.85366E+01 APPROXIMATE FUNCTION VALUES
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR 0.24845E+00 -0.36500E+00 -0.20615E+00 -0.47718E-01 X-VECTOR 0.27338E+02 0.20773E+02 0.15192E+02 0.85366E+01
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR 0.24845E+00 -0.36500E+00 -0.20615E+00 -0.47718E-01 X-VECTOR 0.27338E+02 0.20773E+02 0.15192E+02 0.85366E+01 APPROXIMATE FUNCTION VALUES 0.77766E+02 0.849992+01 0.87271E+02
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION GELTA-X VECTOR 0.24845E+00 -0.36500E+00 -0.20615E+00 -0.47718E-01 X-VECTOR 0.27838E+02 0.20773E+02 0.15192E+02 0.85366E+01 APPROXIMATE FUNCTION VALUES 0.77766E+02 0.849992+01 0.87271E+02 ***********************************
0.77600E+C2 0.84500E+01 0.87220E+02 RESULTS OF APPROXIMATE OPTIMIZATION DELTA-X VECTOR 0.24845E+00 -0.36500E+00 -0.20615E+00 -0.47718E-01 X-VECTOR 0.27338E+02 0.20773E+02 0.15192E+02 0.85366E+01 APPROXIMATE FUNCTION VALUES 0.77766E+02 0.849992+01 0.87271E+02 ***********************************

HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD CL CONSTANT AT A VALUE OF 76.779 CORRECTED FLOSS 77.7300
SURGE MARGIN= 8.4800
EFFICIENCY= 87.2300

PRECISE FUNCTION VALUES 0.77730E+02 0.84800E+01 0.87230E+02
BEGIN ITERATION NUMBER 9
NOMINAL DESIGN NUMBER = 13
X-VECTCR 0.27838E+02 0.20773E+02 0.15192E+02 0.85366E+01
FUNCTION VALUES 0.77730E+02 0.84800E+01 0.87230E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.87768E-01 -0.85184E+00 0.52813E+00 0.10000E+01
X-VECTOR 0.27925E+02 0.19921E+02 0.15720E+02 0.95366E+01
APPROXIMATE FUNCTION VALUES 0.77677E+02 0.84683E+01 0.87235E+02
SET VANE 1 TO 27.93 DEGREES
SET VANE 2 TO 19.92 DEGREES
SET VANE 3 TO 15.72 DEGREES
SET VANE 4 TO 9.54 DEGREES
HOLD RFNC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 CORRECTED FLCH= 77.6500
SURGE MARGIN= 8.4700
EFFICIENCY= 87.2000

PRECISE FUNCTION VALUES 0.77650E+02 0.84700E+01 0.87200E+02
BEGIN ITERATION NUMBER 10
NOMINAL DESIGN NUMBER = 14

X-VECTOR
0.27925E+02 0.19921E+02 0.15720E+02 0.95366E+01
FUNCTION VALUES
0.77650E+02 0.84700E+01 0.87200E+02
and the contract of the fine of the contract o
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.23842E-06 -0.28610E-05 0.28610E-05 -0.28610E-05
X-VECTOR
0.27925E+02 0.19921E+02 0.15720E+02 0.95366E+01
APPROXIMATE FUNCTION VALUES
0.77650E+02 0.84700E+01 0.87200E+02
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SET VANE 1 TO 27.93 DEGREES
SET VANE 2 TO 19.92 DEGREES
SET VANE 3 TO 15.72 DEGREES
SET VANE 4 TO 9.54 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779
CORRECTED FLOH= 77.6500
CURRE MARRIES A 4700
SUPSE MARGIN= 8.4700
EFFICIENCY= 37.2000
南洛斯斯大力的证据是实现现在的种种的基础的基础的基础的基础的基础的

FRECISE FUNCTION VALUES
0.77650E+02 0.84700E+01 0.87200E+02
BEGIN ITERATION NUMBER 11
NOMINAL DESIGN NUMBER = 15
HOUTING DESIGN HOUSEN - 13
X-VECTOR 0.27925E+02 0.19921E+02 0.15720E+02 0.95366E+01
0.27925+02 0.199216+02 0.157206+02 0.953605+01
FUNCTION VALUES
0.77650E+C2 0.84700E+01 0.87200E+02
RESULTS OF AFFROXIMATE OPTIMIZATION
DELTA-X VECTOR
-0.11921E-06 -0.17891E-06 0.0 -0.17881E-06
V. WECTOR
X-VECTOR 0.27925E+02 0.19921E+02 0.15720E+02 0.95366E+01
APPROXIMATE FUNCTION VALUES
0.77550E+02 0.84700E+01 0.87200E+02
TWO CONSECUTIVE APPROXIMATE OPTIMIZATIONS HAVE PRODUCED THE SAME DESIGN
OPTIMIZATION TERMINATED

FINAL RESULT OF APPROXIMATE OPTIMIZATION
NOMINAL DESIGN NUMBER = 15
X-VECTOR 0.27925E+02 0.19921E+02 0.15720E+02 0.95366E+01
FUNCTION VALUES 0.77650E+02 0.84700E+01 0.87200E+02
RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION
TITLE
GLOSAL LOCATIONS OF X-VARIABLES 1 2 3 4
GLOBAL LOCATIONS OF FUNCTIONS, F(X) 8 6 7
APPROXIMATION IS BASED ON 15 DESIGNS
NOMINAL DESIGN IS DESIGN NUMBER 15
VALUES OF X-VARIABLES 0.2793E+02 0.1992E+02 0.1572E+02 0.9537E+01
VALUES OF FUNCTIONS, F(X) 0.7763E+02 0.8470E+01 0.8720E+02
COEFFICIENTS OF TAYLOR SERIES EXPANSION
PARAMETER 1 = GLOBAL VARIABLE 8
LINEAR TERMS, DEL F 0.38405+000.2487E+000.2766E+000.1046E+00
NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT
RON 1 -0.4113E+00
ROIJ 2 -0.1495E-01
RCW 3 -0.1973E-01
RCH 4 0.3927E-01
PARAMETER 2 = GLOBAL VARIABLE 6
LINEAR TERMS, DEL F -0.175CE+00 -0.1113E+00 -0.1378E+00 -0.4375E-01
NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT

-0.232					
RCH 2 -0.211					
RCH 3					
ROW 4	25E-01				
		GLOBAL VARI	IABLE 7		
	TERMS, DEL 54E-02 -0		-0.1099E+00	0.9230E-02	
NON-LIN	EAR TERMS,	H, BEGINI	NG WITH DIAGONA	L ELEMENT	
ROH :	1 90E+00				
ROW 2 -0.11					
RC:1 -0.32					
ROH	4 16E-01			· ·	
	ATION RESU	JLTS			
OBJECTI	VE_FUNCTION LOCATION	8 FU	NCTION VALUE 0	.77650E+02	
DESIGN_	VARIABLES				
10 1	D. V. KO.	GLOBAL VAR. NO.	LOHER BOUND 0.10000E+02	VALUE 0 279255402	UPPER BOUND
2	2	2	0.50000E+01	0.19921E+ 0 2	0.25000E+02
3 4	3 4	3	0.50000E+01 0.50000E+01	0.15720E+02 0.95366E+01	
DESIGN	CONSTRAINI	'S			
	GLOBAL			UPPE	•
10 1	VAR. NO		ND VALL E+01 0.84700E	JE BOU: :+01 0.10000	ND E+03
3	7	0.87000	E+020.872008	+020.10000	E+04
*****	**_FINAL	SOLUTION V	ALUES *****		
VANE AN	GLE FOR VA	NE 1 IS	27.93 DEG	GREES	
VARE AH	GLE FOR VA	NE 2 IS	19.92 DEG	REES	·
VANE AN	GLE FOR VA	NE 3 IS	15.72 DEG	REES	
VÄHE ÄN	GLE FOR VA	NE 4 IS	9.54 DEG	REES	
			,.54 566	metu	
CORRECT	ED FLCW= 7	7.6500			

EFFICIENCY= 87.2000

SURSE MARGIN= 8.4700

RFNC WAS HELD CONSTANT AT 5567.50

OL WAS HELD CONSTANT AT 76.78

PROGRAM CALLS TO ANALIZ

ICALC CALLS

1 1 1
2 15
3 1

STATOR VANE OPTIMIZER ******* PROTOTYPE SOFTWARE CAPABLE OF GUIDING THE OPTIMIZATION OF __ STATOR VANE AND BLEED SETTINGS IN A MULTI-STAGE COMPRESSOR FREPARED FOR THE AIR FORCE AERO PROPULSION LABORATORY UNDER CONTRACT F33615-79-C-2013 BY: PRATT & WHITHEY AIRCRAFT GROUP GOVERNMENT PRODUCTS DIVISION PLEASE HIT RETURN TO VIEW OPTIMIZATION GOAL MENU I OPTIMIZATION CONDITIONS I CONSTRAINTS I NO I GOAL I REMC WC PR DVS O.L. I S.M. I EFF I 1.1... х Х 2 I EFF Х Х I 3 I EFF I MIN I EFF IX X 4 I EFF EFF I MIN I 5 I I_X 6 I X I MIN I 7 I I S.M. 8 I S.M. 9 I S.M._ 10 I S.M. I X I MIN 11 I S.M. I MIN 12 I S.M. I 13 I SM/BLD I X I HIN I HIN 14 I HAX HC I I MIN I MIN 15 I MIN NO I I MIN I MIN FR I X X 16 I Х I MIN I MIN I 17 I ΕŻ YOU HAVE SELECTED TO OPTIMIZE PRESSURE RATIO HOLDING CORRECTED SPEED (RPMC) AND OFERATING LINE (OL) CONSTANT THILE CONSTRAINING SURGE MARGIN AND EFFICIENCY TO MINIMUM VALUES HOLD REMC CONSTANT AT 5557.500 HOLD OL CONSTANT AT OPTIMIZING 4 VANE ANGLE(S) LOHER COULD FOR VANE 1 IS 10.000 DO YOU AGREE? (Y/N) LOWER DOWND FOR VANE 2 IS 5.000 DO YOU ACREE? (Y/N) LONER DOUND FOR VANE 3 IS 5.000 DO YOU AGREE? (Y/N) LOWER EQUIND FOR VANE 4 IS 5.000 DO YOU AGREE? (Y/N) "UPPER BOUND FOR VANE 1" IS" 35.000 DO YOU AGREE? (Y/N) UPFER EQUID FOR VANE 2 IS DO YOU ASSES (YAN) UPPER BOUND FOR VANE 3 IS 25.000 DO YOU AGREE? (YZN) UPPER DOUND FOR VANE 4 IS 25.000 DO YOU AGREE? (Y/N) IS LCHER BOUND VALUE FOR SH 8.500 UPPER COUND VALUE FOR SIT IS 100.000 LCHER EDUND VALUE FOR EFF IS 87.000 UPFER DOUND VALUE FOR EFF IS 1000.000 INCREMENTAL VAME ANGLE VALUE FOR INITIAL VANE SETTING IS -2.00

CONTROL	PARAME	TERS;					
CALCULA	TICH CC	NTROL,		NCAL	LC =	6	
NUMBER	OF GLOB.	AL DESIS	N VARTABI	ES. NI)V =	4	
NUTBER .	OF SENS	YTIVITY	VARIABLES), N	5V =	0	
NUMBER	OF FUNC	TIONS IN	THO-SPAC	E. N2V	AR =	0	
NUMBER	OF APPR	TAMIXO	VARIABLES I THO-SPAC IS VAR. IT_CODE,	NXAP	2X =	4	
INPUT I	NEORMAT	ION PRIN	IT CODE.	IPNPL	JT =	i	
DECUG F	RINT CO	DE,		IPOS	33 =	0	
CALCIIIA	TICN CO	SITONI . A	CALC				
VALUE	ME SHITE	G .					
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2	OPTIMI						
7	CENTER	ZATEGN Tutty					
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5	007794	M CENCAL	IVITY	JFAUE			
			PTINIZATIO	NA.			
U	AFPROX	TIMIE OF	. 1 TH 1 TW 1 TK	· 4			
MULTIPL	IER (NE	GATIVE 1	R OF OBJECTION OF THE CONTRACT	HINIMIZ	ATION) =	0.10	00E+01
MULTIPL COMMIN IPRINT	IER (NE PÄRÄMET ITMAX	GATIVE 1 ERS (IF ICHDIR	ZERO, COM	MINIMIZA MIÑ DEFA ITRM	= (MOITA LIW TJUL LINCBJ	0.10 L OVER	00E+01 -RIDE) X1 NF
MULTIPL COMMIN IPRINT 5	IER (NE PARAMET ITMAX 20	GATIVE 1 ERS (IF ICHOIR 5	ZERO, CON MISCAL 0	MINIMIZA MIN DEFA ITRM 3	ATION) = AULT WIL LINCES 0	U OVER	00E+01 -RIDE) X1 NF
MULTIPL COMMIN IPRINT 5	IER (NE PARAMET ITMAX 20	GATIVE 1 ERS (IF ICHOIR 5	ZERO, CON MISCAL 0	MINIMIZA MIN DEFA ITRM 3	ATION) = AULT WIL LINCES 0	U OVER	00E+01 -RIDE) X1 NF
MULTIPL COMMIN IPRINT 5 FDCH 0.1000	IER (NE PARAMET ITMAX 20 CE-01	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100	ZERO, COM MSCAL 0 1 0 10 000E-02	MINIMIZATION DEFA	ATION) = AULT WILL LINCES O	O.10 L OVER NACH 10 CTH	00E+01 -RIDE) X1 NF 0
MULTIPL COUNTIN IPRINT 5 FDCH 0.1000	IER (NE PARAMET ITMAX 20 CE-01	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100	ZERO, COM MSCAL 0 1 1 1000E-02	MINIMIZATION DEFA	ATION) = AULT WILL LINCES O	O.10 L OVER NACH 10 CTH	00E+01 -RIDE) X1 NF 0
HULTIPL COMMIN IPRINT 5 FDCH 0.1000 CTL -0.1000	IER (NE PARAMET ITMAX 20 0E-01	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100	ZERO, CON R MSCAL 0 1 1 0 000E-02	HINIMIZA HIN DEFA ITRM 3 CT -0.5000 THETA 0.1000	LINCBJ OCE-01	O.10 L OVER NACN 10 CTM 0.4 PHI	00E+01 -RIDE) X1 NF 0
HULTIPL COMMIN IPRINT 5 FDCH 0.1000 CTL -0.1000	IER (NE PARAMET ITMAX 20 0E-01	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLH: 0.100 DABFU	ZERO, CON R MSCAL 0 1 1000E-02	HINIMIZA HIN DEFA ITRM 3 CT -0.5000 THETA 0.1000	LINCBJ OCE-01	O.10 L OVER NACN 10 CTM 0.4 PHI	00E+01 -RIDE) X1 NF 0
HULTIPL COMMIN IPRINT 5 FDCH 0.1000 CTL -0.1000	IER (NE PARAMET ITMAX 20 0E-01	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100	ZERO, CON R MSCAL 0 1 1000E-02	HINIMIZA HIN DEFA ITRM 3 CT -0.5000 THETA 0.1000	LINCBJ OCE-01	O.10 L OVER NACN 10 CTM 0.4 PHI	00E+01 -RIDE) X1 NF 0
MULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 VE-02 VARIABL	GATIVE 1 ERS (IF ICHOIR 5 FDCHN 0.100 CTLM1 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	THETA 0.1006	ATION) = AULT WILL LINCBJ 0 DOE-01 DOE+01 COE+00	O.10 L OVER NACM 10 CTM 0.4 PHI 0.0 ABC 0.1	PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF THE PARTOR OF T
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL O 1 1 000E-02 IN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL O 1 1 000E-02 IN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL O 1 1 000E-02 IN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL O 1 1 000E-02 IN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL O 1 1 000E-02 IN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL O 1 1 000E-02 IN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000	IER (NE PARAMET ITMAX 20 CE-01 CE-01 CE-02 VARIABLE CARAMET CARAMET CARAMETER (NE CARA	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0	CHDICATES ZERO, CON R MSCAL 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000 DESIGN NOM-ZER D. V. NO. 1 2 3 4	IER (NE PARAMET ITMAX 20 CE-01 OE-02 VARIABL OINITI LOUIS 0.1000 0.5000 0.5000 0.5000	GATIVE 1 ERS (IF ICHOIR 5 FDCH: 0.100 CTLM: 0.100 DABFU 0.0 E INFORMAL VALUE R COCHOI 000000000000000000000000000000000000	EMPLCATES ZERO, COM R MSCAL 0 1 000E-02 IN MATICN E WILL OVE UPPER BOUND 0.35000E 0.25000E 0.25000E	HINIMIZA ITRM 3 CT -0.5000 THETA 0.1000 ALPMAN 0.1000	ATION) = AULT WILL LINCBL 0 00E-01 00E+01	O.10 L OVER NACH 10 CTM 0.4 PHI 0.0 ABC	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000 DESIGN NOM-ZER D. V. NO. 1 2 3 4	IER (NE PARAMET ITMAX 20 CE-Ol OE-Ol OE-Ol OE-OL OINITI LOUIS DOUR 0.5000 0.5000 VARIABI	GATIVE 1 ERS (IF ICHOIR 5 FDCHN 0.100 CTLM1 0.100 DABFU 0.0 E INFORNAL VALUE R COE+02 0E+01 0E+01 0E+01	EMPICATES ZERO, CON R NSCAL 0 1 1000E-02 EN MATICN E WILL OVE UPPER BOUND 0.35000E 0.25000E 0.25000E	HINIMIZATION DEFA	ATION) = AULT WILL LINCBJ 0 DOE-01 DOE+01 COULE I INITIAL VALUE 0.15000E 0.13000E	0.10 L OVER NACM 10 CTM 0.4 PHI 0.0 ABC 0.1 NPUT +02 +02 +01	PJI
HULTIPL COMMIN IFRINT 5 FDCH 0.1000 CTL -0.1000 DELFUN 0.1000 DESIGN NOM-ZER D. V. NO. 1 2 3 4	IER (NE PARAMET ITMAX 20 CE-Ol OE-Ol OE-Ol OE-OL OINITI LOUIS DOUR 0.5000 0.5000 VARIABI	GATIVE 1 ERS (IF ICHOIR 5 FDCHN 0.100 CTLM1 0.100 DABFU 0.0 E INFORNAL VALUE R COE+02 0E+01 0E+01 0E+01	EMPLCATES ZERO, COM R MSCAL 0 1 000E-02 IN MATICN E WILL OVE UPPER BOUND 0.35000E 0.25000E 0.25000E	HINIMIZATION DEFA	ATION) = AULT WILL LINCBJ 0 DOE-01 DOE+01 COULE I INITIAL VALUE 0.15000E 0.13000E	0.10 L OVER NACM 10 CTM 0.4 PHI 0.0 ABC 0.1 NPUT +02 +02 +01	PJI

3	3		3	0.1	0000E+01				
CCHST	RAINT	IN	FORMATIO	N			and the second s	and the same of th	
THERE	ARE	2	CONSTRAI	NT SETS					
	GLODA	٩Ľ	GLOBAL	LINEAR	LCHER		NORMALIZATION	UPPER	NORMALIZATION
ID	VAR.	1	VAR. 2	ID	BOUND		FACTOR	BOUND	FACTOR
1	6		6	0	0.85000	E+01	0.85000E+01	0.10000E+03	0.10000E+03
3	7		7	0	0.87000	E+02_	NORMALIZATION FACTOR 0.85000E+01 0.87000E+02	0.10000E+04	0.10000E+04
TOTAL	ופאניא.	ER	OF CONST	RAINED PA	ARAMETERS	=	2		
* * A	FFROX	IMA	TE ANALY	SIS/OPTI	I MOITASIN	NFORM	ATION	and the second s	
פסונטא	ROF	FUN	CTIONS A	PPROXIMA	TED, NF =_	0			
NUMBE	R OF	LHE	UT X-VEC	TCRS,	NFS = NPFS =	5			
NUMBE	R OF	II:P	UT X-F P	AIRS,	NPFS =	0			
X-VEC	TOR FI	ROM	ANALIZ,		NPA = INCM = ISCRX = ISCRXF =	0			
NOTIN	AL DES	SIU	N, V VECTO	ne					
READ	10177	こしょく	X-VECTO	RD, De	ISURX =	5			
READ FOTH	י בינוט י מדנימים	7 U.R 2 M I	A-L PAI	K3,	IPAFRX =	1			
			-			_			
MINI	un ÁP	e e e	XIMATING	CYCLES	KMIN =	5			
MAXIN	UM AF	כהק	XIMATING	CYCLES,	KMAX =	17			
MAXIII	IUM DES	SIC	NS USED	IN FIT,	NFMAX =	28			
ROHEN	INL DES	SIG	N PARAME	TER,	_ JHOM = _	28			
X-FCC	HOLTA	I:	TUT PARA	METER,	INXLOC = INFLOC =	0			
F-LCC	ATICH	I:	PUT PARA	METER,	INFLOC =	0			
TATLE	R SERI	LES	1.0. 00	UE,	MAXTEM =	2			
0.200	CE+01	0	.2000E+0	1 0.200	E OPTIMIZA DE+01 0.2	000E+			
MULTI	FLIER	ON	CELX,		XFACT1 =	0.15	005+01		
MULTI	PLIER	CH	DELX,		XFACT1 = XFACT2 =	0.20	00E+01		
			CHS OF X	-Váriábli	ES			arter de cales arteras des Arters de Cares de Ca	
	L LCC			UNCTIONS					
X-VEC	: '2 5'01'	INP	UT FROM	UNIT!	5		engan nga minahanya pilip dalihak Miya anganit s		
NUMBE 0.290			DESIG .1800E+0		DE+02 Ó.1	100E+	02		
NUMBE	:R	2	DESIG	N 2					

NUMBER 3 DESIGN 3 0.2700E+02 0.1600E+02 0.1500E+02 0.1100E+02 NUMBER 4 DESIGN 4 0.2700E+02 0.1600E+02 0.1300E+02 0.1100E+02 NUMBER 5 DESIGN 5 0.27005+02 0.1600E+02 0.1300E+02 0.9000E+01 * * ESTIMATED DATA STORAGE REQUIREMENTS INPUT EXECUTION AVAILABLE INFUT EXECUTION AVAILABLE 41 355 5000 30 79 1000 INTEGER SET VANE 1 TO 29.00 DEGREES SET VAME 2 TO 18.00 DEGREES SET VAME 3 TO 15.00 DEGREES SET VINE 4 TO 11.00 DEGREES HOLD PRIC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 PRESSURE RATIO# 5.5330 SURGE MARGINE 8.3000 EFFICIENCY= 87.1400 ********* ******* SET VARIE 1 TO 27.00 DEGREES SET VANE 2 TO 18.00 DEGREES SET VANE 3 TO 15.00 DEGREES SET VANE 4 TO 11.00 DEGREES HOLD RPHC CONSTANT AT A VALUE OF 5567.500 HOLD OL CCHOTANT AT A VALUE OF 76.779 PRESSURE RATIO= 5.5970 SURGE MARGIN= 8.7400

0.2700E+02 0.1800E+02 0.1500E+02 0.1100E+02

SET VANE 1 TO 27.00 DEGREES
SET_VANE 2 TO 16.00 DEGREES
SET VANE 3 TO 15.00 DEGREES
SET VANE 4 TO 11.00 DEGREES
HOLD REMC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 FRESSURE RATIO= 5.6290
SURGE MARGIN= 8.8700
EFFICIENCY= 87.2400
被延迟近期收收过度强强被收收的证券的基础的证券的证券的证券的证
张宗武张祥章《武汉政张政义》《宋汉汉张张棻明书《李宗武》《李宗武张
SET VANS 1 TO 27.00 DEGREES
SET VANE 2 TO 16.00 DEGREES
SET VARIE 3 TO 13.00 DECREES
SET VANE 4 TO 11.00 DEGREES
HOLD RENC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 FRECOURE RATIO= 5.6500
SUPCE MARGIN= 9,1400
EFFICIENCY= 87.2700
利斯内斯莫斯斯巴米米尔斯米尔斯沃米人斯安斯斯米米米斯米米斯米米斯米斯斯
· · · · · · · · · · · · · · · · · · ·
SET VANE 1 TO 27.00 DEGREES
, SET VANE 2 TO 16.00 DEGREES
SET VANE 3 TO 13.00 DEGREES
SET VANG 4 TO 9.00 DEGREES
HOLD RENG CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 FRESSURE RATIO= 5.6830
SURGE MARGIN= 9.2000
EFFICIENCY= 87.3200

EFFICIENCY=

87.3200

APPROXIMATIN	G FUNCTION 1 IS THE OBJECTIVE
APPROXIMATIN 2 3	S FUNCTIONS ASSOCIATED WITH CONSTRAINTS
DESIGN VARIA	BLE NUMBERS ASSOCIATED WITH APPROXIMATING VARIABLES 3 4
BEGIN ITERAT	TICN NUMBER 1
_NOMINAL DESI	IGN NUMBER = 5
X-VECTOR 0.27000E+0	02 0.16000E+02 0.13000E+02 0.90000E+01
FUNCTION VAL 0.56030E+0	UES 21 0.92000E+01 0.87320E+02
RESULTS OF A	PPROXIMATE OPTIMIZATION
DELTA-X VECT	TGR 01 -0.20000E+01 -0.20000E+01 -0.20000E+01
X-VECTOR 0.25000E+0	02 0.14000E+02 0.11000E+02 0.70000E+01
0.58330E+0	FUNCTION VALUES D1 0.10100E+02 0.87500E+02
SET VARE 1 T	O 25.00 DEGREES
SET_VARE 2_1	0 14.00 DEGREES
SET VANE 3 1	TO 11.00 DEGREES
SET VANE 4 1	TO 7.00 DEGREES
HOLD REMO CO HOLD OL CO FRESSURE RAT	ONSTANT AT A VALUE OF 5567.500 CHSTANT AT A VALUE OF 76.779 FIO= 5.8390
SURGE MARGIN	
EFFICIENCY=	87.4000

BEGIN ITERATION NUMBER 2
NOMINAL DESIGN NUMBER = 6
X-VECTOR 0.25000E+02 0.14000E+02 0.11000E+02 0.70000E+01
FUNCTION VALUES 0.50390E+01 0.96400E+01 0.87400E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR -0.3000E+01 0.80461E+00 -0.20000E+01 -0.20000E+01
X-VECTCR 0.22000E+02 0.14805E+02 0.90000E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.59364E+01 0.90052E+01 0.87445E+02
SET VAME 1 TO 22.00 DEGREES
SET VANE 2 TO 14.80 DEGREES
SET VANE 3 TO 9.00 DEGREES
SET VALLE 4 TO 5.00 DEGREES
HOLD PENC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 FRESSURE RATIO= 5.9580
SURCE MARGINE 10.0200
SFFICIENCY= 87.3100

PRECISE FUNCTION VALUES 0.59580E+01 0.10020E+02 0.87310E+02
SEGIN ITERATION NUMBER 3
NOMINAL DESIGN NUMBER = 7
X-VECTOR 0.22000E+02 0.14805E+02 0.90000E+01 0.50000E+01
FUNCTION VALUES 0.59530E+01 0.10020E+02 0.87310E+02

OPTIMIZATION HAS PRODUCED AN X-VECTOR WHICH IS THE SAME AS A PREVIOUS DESIGN
DELTA-X VECTOR
0.36198E-06 -0.73096E-06 -0.92256E-06 -0.97167E-06
X-VECTOR 0.22000E+02_0.14805E+02_0.90000E+01_0.50000E+01
THE FOLLOWING DESIGN IS NOT THE APPROXIMATE OPTIMUM
DELTA-X VECTOR
0.60000E-01 0.59999E-01 0.39999E-01 0.19999E-01
X-VECTOR
0.22060E+02 0.14855E+02 0.90400E+01 0.50200E+01
ADDONAMATE EINICTION VALUES
APPROXIMATE FUNCTION VALUES 0.59543E+01 0.10024E+02 0.87317E+02
######################################
The second secon
APT HAVE A SA AA BEGREEN
SET VANE 1 TO 22.06 DEGREES
SET VAME 2 TO 14.86 DEGREES
SET VANE 3 TO 9.04 DEGPEES
SET VANE 4 TO 5.02 DEGREES
HOLD OL CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 75 779
HOLD OL CONSTANT AT A VALUE OF 75 779
FRESSURE RATIO= 5.9550
SURGE MARGIN= 9.9900
EFFICIENCY= 87.3200
斯伯斯斯斯特尔斯比赛卢法典斯·斯特列基州特别 5.2000 美国 斯斯斯 斯斯
words and the state of the stat
PRECISE FUNCTION VALUES
0.555552+01 0.99900E+01 0.87320E+02
With the part of the second of
CIGIN ITERATION NUMBER 4
NOMINAL DESIGN NUMBER = 8
X-VECTOR
0.22050E+02 0.14865E+02 0.90400E+01 0.50200E+01
FUNCTION VALUES
0.59550E+01

RESULTS OF APPROXIMATE OPTIMIZATION

RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR 0.69780E+00 -0.99378E+00 -0.46939E+00 -0.20000E-01
X-VECTOR 0.22758E+02 0.13871E+02 0.85706E+01 0.50000E+01
APPROXIMATE FUNCTION VALUES 0.59993E+01 0.65006E+01 0.87510E+02
SET_VARE I TO 22.76 DEGREES
SET VANE 2 TO 13.87 DEGREES
SET VANE 3 TO 8.57 DEGREES
SET VANE 4 TO 5.00 DEGREES
HOLD RAMIC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779 FRESSURE RATIO= 5.9630
SUTGE MARGIN= 9.9900
EFFICIENCY= 87.3200
推订表汇产款收货股份收货款款贷款按收款收货款款收收款款
PRECISE FUNCTION VALUES 0.55330E+01 0.99900E+01 0.87320E+02
BEGIN ITERATION NUMBER 5
HOMINAL DESIGN NUMBER = 9
X-VECTOR 0.22750E+02 0.13871E+02 0.85706E+01 0.50000E+01
• FUNCTION VALUES 0.59030E+01 0.99900E+01 0.87320E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DTLTA-X VECTCR -0.26599E+01 -0.30000E+01 0.19486E+01 0.0
X-VECTOR 0.20000E+02 0.10871E+02 0.10519E+02 0.50000E+01
APPROXIMATE FUNCTION VALUES

0.60790E+01 0.10146E+02 0.8712\E+02

SET VANE 1 TO 20.09 DEGREES	
SET VAME 2 TO 10.87 DEGREES	
SET VANE 3 TO 10.52 DEGREES	-
SET VANE 4 TO 5.00 DEGREES	
HOLD REHIC CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779	
FRESSUPE RATIO= 6.0360 SURGE MARGINE 10.0800	_
EFFICIENCY= 86.9100	
我帮助的人。这样也有有证明的证明的证明的证明的证明的证明的证明的证明的证明的证明的证明的证明的证明的证	
PRECISE FUNCTION VALUES	
0.6036CE+01 0.10080E+02 0.86910E+02	
DESIN ITERATION NUMBER 6	
NOMINAL DESIGN NUMBER = 10	
X-VECTOR	
0.20033E+02 0.10871E+02 0.10519E+02 0.50000E+01	
FUNCTION VALUES	
0.60360E+01	
RESULTS OF APPROXIMATE OPTIMIZATION	
BELTA-X VECTOR	
0.15720E+01 -0.30000E+01 0.10368E+01 0.0	
X-VECTOR	
0.21660E+02 0.78708E+01 0.11606E+02 0.50000E+01	
AFFICEINATE FUNCTION VALUES	
0.61003E+01 0.66785E+01 0.87345E+02	
SET VANE 1 TO 21.66 DEGREES	
SET VANE 2 TO 7.87 DEGREES	
SET VANE 3 TO 11.61 DEGREES	
SET VANE 4 TO 5.00 DECREES	

FRES	SURE RATIO	0=_ 6,0270		
SURG	E MARGIN=	9.9100		
EFFI	CIENCY=	86.8300		
***	为世界安徽等	*****	*****	
	6027 0E+ 01	ION VALUES 0.99100E+0		
BEG1	N ITERATI	ON NUMBER	7	
Nena	HAL DESIG	H HUMBER =	11	
	SOTOR			
0	21660E+02	0.78703E+0	10.116	06E+020.50000E+0
	TION VALU			
0.	6027 0 E+01	0.99100E+0	1 0.868	30E+02
RESU	LTS OF AP	PROXIMATE OF	TIMIZATI	0N
	A-X VECTO			
٥.	412675-01	0.73487E-0	1 -0.300	00E+01 -0.35763E-06
	CTCR			/
	217015+02	0.79443E+0	10.8600	60E+01_0.50000E+01
		UNSTION VALU		715.00
		0.10023E+0 **********		315+05
SET	VANE 1 TO	21.70 DEG	REES	
SET	VANE 2 TO	7.94 DEG	REES	
SET	VAME 3 TO	8.61 DEG	REES	
SET	VANE 4 TO	5.00 DEC	REES	
HOLE	RENC CON	STANT AT A V	ALUE OF	5567.500
HOL	OL CC!	STANT AT A V	ALUE_OF_	5567.500 76.779
FRE	JURE RATI	U= 6.0693		
SURC	SE MARGIN=	10.1900		
		66.8800		

BEGIN ITERATION NUMBER 8	
NOMINAL DESIGN NUMBER = 12	
X-VECTOR	
0.21701E+02 0.79443E+01 0.86060E+01 0.50000	E+0
FUNCTION VALUES	
0.60690E+01 0.10190E+02 0.86880E+02	
* * CONMIN DETECTS INITIAL X(I).LT.VLB(I)	
X(I) = 0.0 VLB(I) = 0.9537E-06 X(I) IS SET EGUAL TO VLB(I) FCR I = 4	
ACI, 15 514 EQUAL TO YESCI, FUR I - 4	
RESULTS OF APPROXIMATE OPTIMIZATION	
DELTA-X VECTOR	
C.11016E+010.24208E+010.3000CE+010.21580	E-0
X-VECTOR	
0.20600E+02 0.10365E+02 0.56060E+01 0.50000	E+0
APPROXIMATE FUNCTION VALUES	
0.61052E+01 0.10423E+02 0.86997E+02	

SET VAME 1 TO 20.60 DEGREES	
SET VANE 2 TO 10.37 DEGREES	
SET VANE 3 TO 5.61 DEGREES	
SET VANE 4 TO 5.00 DEGREES	
HOLD REMC COMSTANT AT A VALUE OF \$567.500	
HOLD OL CONSTANT AT A VALUE OF 76.779	
FRECEURE RATIO= 6.1030	
SURGE MARGIN= 10.1800	
EFFICIENCY= 86.8200	

BEGIN ITERATION NUMBER 9
NCHINAL DESIGN NUMBER = 13
X-VECTOR 0.20600E+02_0.10365E+02_0.56060E+01_0.50000E+01
FUNCTION VALUES 0.61030E+01 0.10180E+02 0.86920E+02
RESULTS OF APPROXIMATE OPTIMIZATION
DELTA-X VECTOR
0.44074E+00 -0.21178E+00 -0.60598E+00 0.0
X-VECTCR 0.21040E+02_0.10153E+02_0.50000E+01_0.50000E+01
AFPROXIMATE FUNCTION VALUES 0.61058E+01 0.10138E+02 0.85828E+02
SET VANE 1 TO 21.04 DEGREES
SET V/NE 2 TO 10.15 DECREES
SET VANE 3 TO 5.00 CECREES
SET VANE 4 TO 5.00 DEGREES
HOLD REMS CONSTANT AT A VALUE OF 5567.500 HOLD OL CONSTANT AT A VALUE OF 76.779
FRESSURE RATIO= 6.1020
SURGE MARGIN= 10.2100
EFFICIENCY= 86.8000

PRECISE FUNCTION VALUES 0.610202+01 0.10210E+02 0.86800E+02
BEGIN ITERATION NUMBER 10
NOMINAL DESIGN NUMBER = 14
X-VECTOR 0.21040E+02 0.10153E+02 0.50000E+01 0.50000E+01
FUNCTION VALUES
0.61020E+01 0.10210E+02 0.86800E+02

RESULTS OF APPROXIMATE OPTIMIZATION

DELTA-X VECTOR				
-0.53784E-07	0.0	0.0	0.0	
X-VECTOR				
	0.10153E+02	0.50000E+01	L_ 0.50000E+01	
THE FOLLOWING	DESIGN IS NO	T THE APPROXI	MATE OPTIMUM	
DELTA-X VECTOR	1			
0.20000E-01	0.20000E-01	0.10000E-01	0.10000E-01	
X-VECTOR				
	_0.10173E+02	0.50100E+01	0.50100E+01	
APPROXIMATE FU	PICTION VALUE	c		
	0.102105+32		2	
*********	****	****		
SET VARE 1 TO	21.06 DEGR	EES		
SET VANE 2 TO	10.17 DEGR	FFS		
SET VANE 3 TO	5.01 DEGR	EES		
SET VALLE 4 TO	5.01 DEGR	EES		
HOLD REMC CONS	AV A TA THAT	LUE OF F	5547 500	
HOLD OL COM	TANT AT A VA	LUE OF	76.779	
PRESSURË RATIO	= 6.1050			
SURGE MARGIN=	10.1500			
EFFICIENCY=	86 8200			
Eri Ioiino.	03.0200			
**************************************	******	****		
FRECISE FUNCTI	CH VALUES			
0.61059E+01		0.86320E+0		
FINAL RESULT O	F APPROXIMATE	E OPTIMIZATIO	N	
NOMINAL DESIGN	NUMBER = 1	15		
. veeren			and the second second	
X-VECTOR	0 101775400	0 503005+03	0.50100E+01	

RESULTS OF APPROXIMATE ANALYSIS/OPTIMIZATION

GLOBAL LOCATIONS OF X-VARIABLES 1 2 3 4
GLOSAL LOCATIONS OF FUNCTIONS, F(X) 9 6 7
APPROXIMATION IS BASED ON 15 DESIGNS
NOMINAL DESIGN IS DESIGN NUMBER 15
VALUES OF X-VARIABLES 0.2106E+02 0.1017E+02 0.5010E+01 0.5010E+01
VALUES OF FUNCTIONS, F(X) 0.6105E+01 0.1015E+02 0.8682E+02
COEFFICIENTS OF TAYLOR SERIES EXPANSION
PARAMETER 1 = GLOBAL VARIABLE 9
LIMEAR TERMS, DEL F -0.2044E-01 -0.1362E-01 -0.1451E-01 -0.1750E-01
NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT
RGH 1 -0.1649E-02
FOH 2 -0.5373E-03
RON 3 0.3395E-04
RCH 4 0.6555E-03
PARAMETER 2 = GLOBAL VARIABLE 6
LINEAR TERMS, DEL F -0.4634E-01 -0.1312E-01 0.4856E-01 0.7715E-01
NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT
ROW 1 -0.2460E-01
RO:4 2 -0.3261E-02
ROW3
RC'1 4 -0.1294E-01

PARAMETER 3 = GLOBAL VARIABLE 7
LINEAR TERMS, DEL F 0.1044E+00 0.6735E-01 0.5474E-01 -0.4966E-02
NON-LINEAR TERMS, H, BEGINING WITH DIAGONAL ELEMENT
ROW 1 -0.2775E-01
ROW 2 -0.3713E-02
RCH 3 -0.9915E-02
RCM 4 -0.4343E-02
OPTIMIZATION RESULTS
GBJECTIVE FUNCTION GLOBAL LOCATION 9 FUNCTION VALUE 0.61050E+01 DESIGN VARIABLES
D. V. GLOBAL LOWER UPPER ID NO. VAR. NO. BOUND VALUE BCUND 1
2 2 2 0.50000E+01 0.10173E+02 0.25000E+02 3 3 0.50000E+01 0.50100E+01 0.25000E+02 4 4 0.50000E+01 0.50100E+01 0.25000E+02
DESIGN CONSTRAINTS
GLOBAL LOWER UPPER IO VAR. NO. EOUND VALUE BOUND 1 6 0.85000E+01 0.10150E+02 0.10000E+03 3 7 0.87000E+02 0.86800E+00 0.10000E+04
**** *** FINAL SOLUTION VALUES ******
VAME ANGLE FOR VANE 1 IS 21.06 DEGREES
VARIE ANGLE FOR VANE 2 IS 10.17 DEGREES
VANE ANGLE FOR VANE 3 IS 5.01 DESREES
VANE ANGLE FOR VANE 4 IS 5.01 DEGREES
FRESSURE RATIO= 6.1050
EFFICIENCY= 86.8000
SURGE MARGIN= 10.1500
RENC WAS HELD CONSTANT AT 5567.50 OL WAS HELD CONSTANT AT 76.78
PROGRAM CALLS TO ANALIZ
ICALC CALLS
2 15 3 1

DATE FILME O-8